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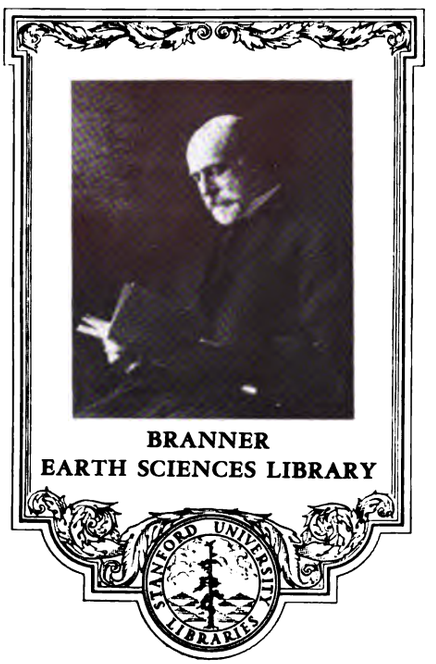
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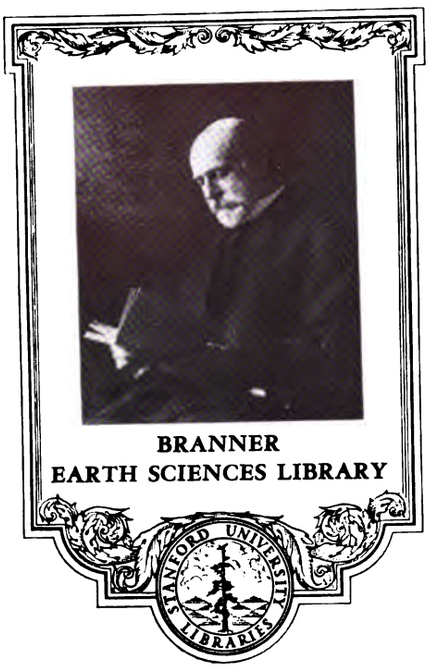
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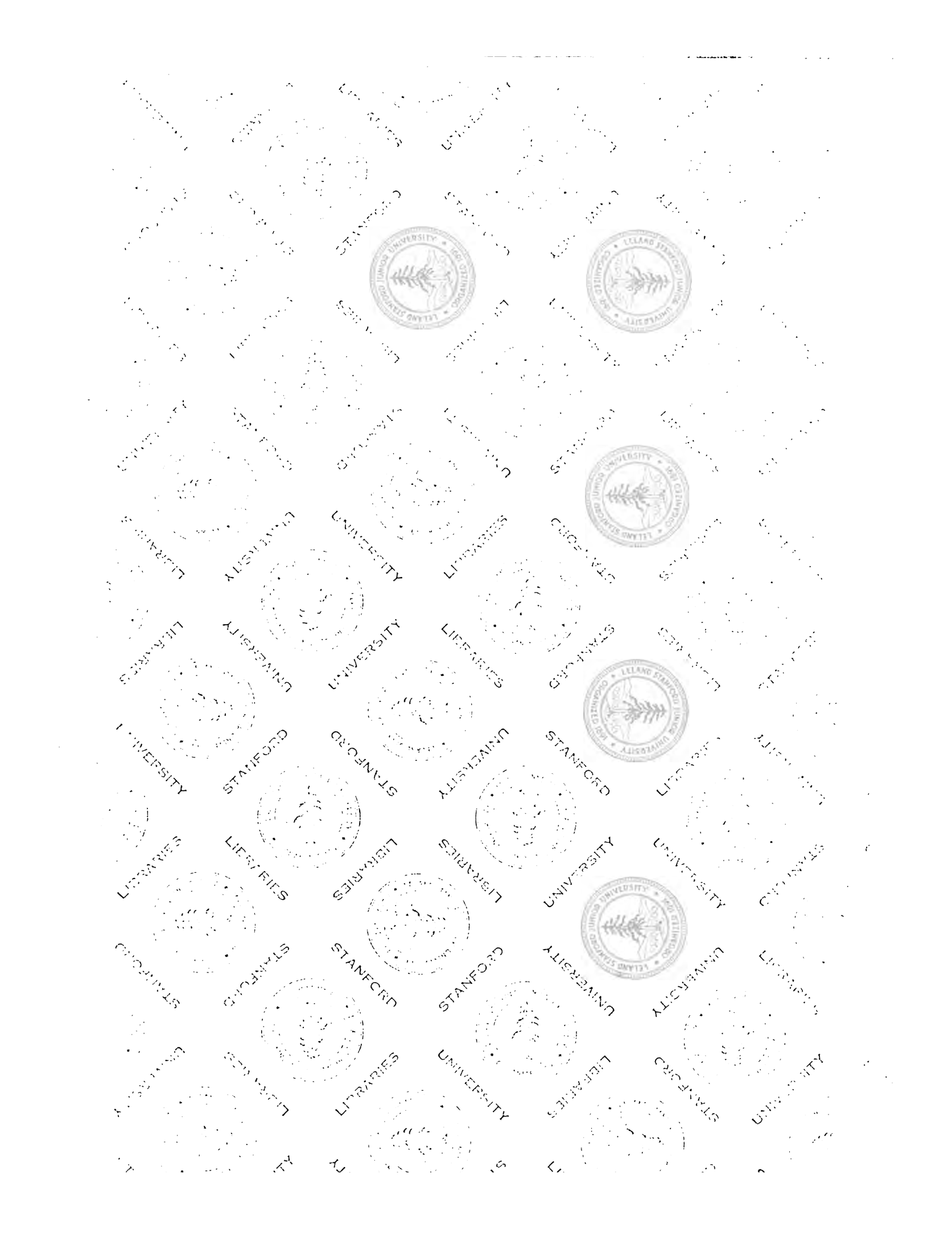

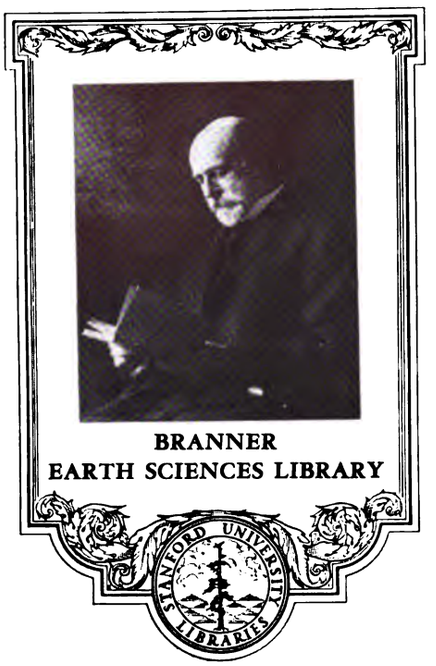
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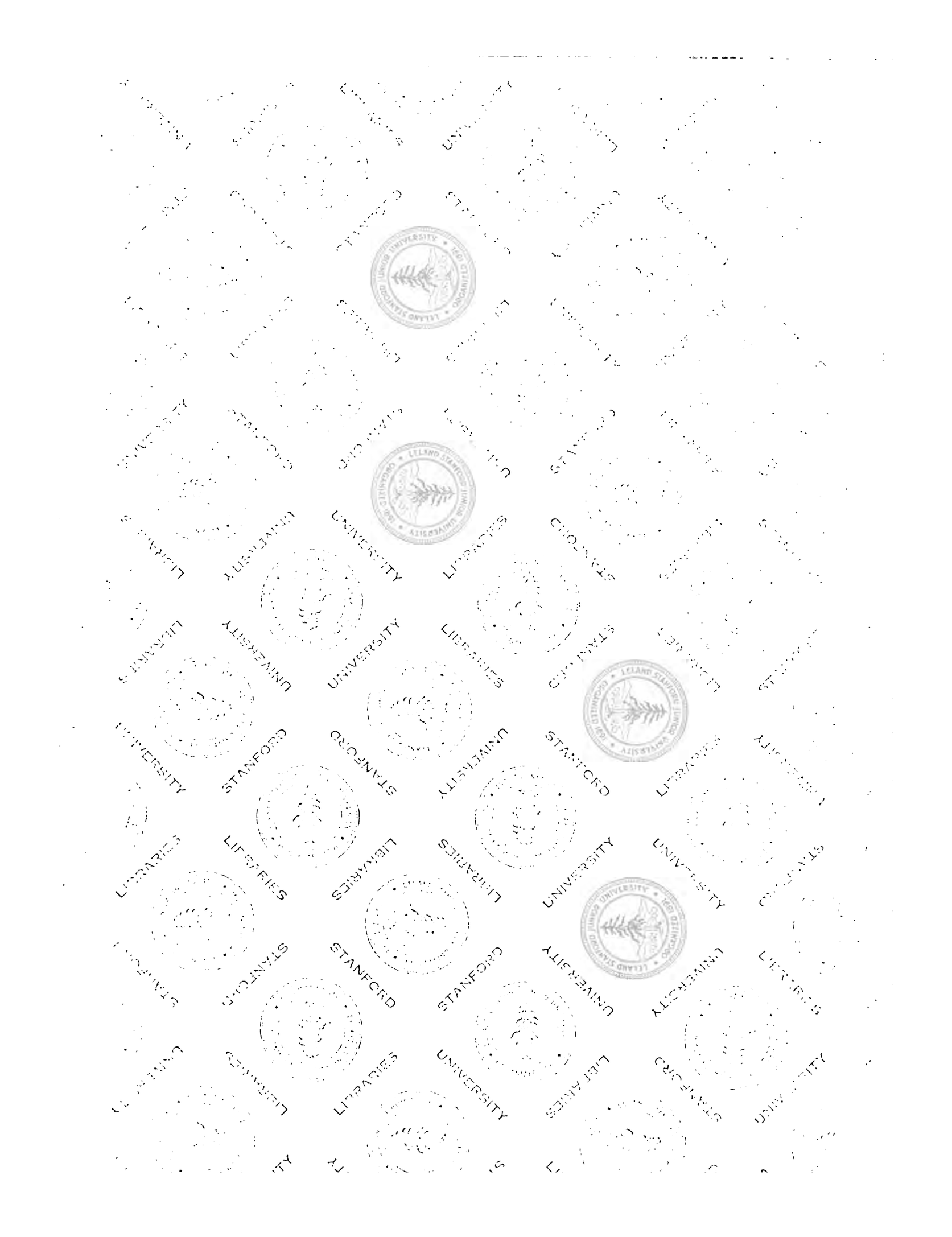
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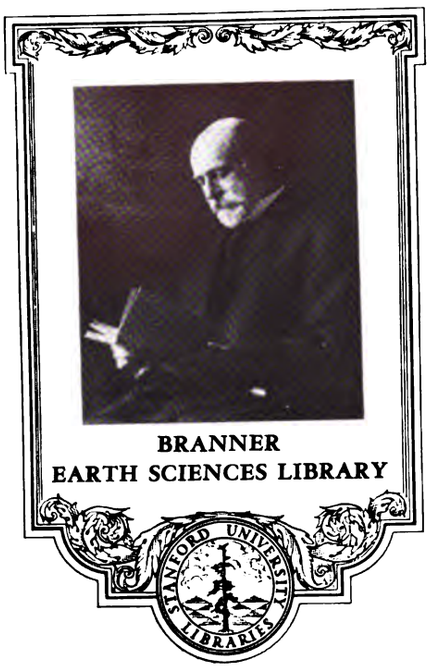
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THE

FORESTS OF OREGON

BY

HENRY GANNETT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1902

Professional Paper No. 4 Series H, Forestry, 1

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., June 17, 1902.

SIR: I transmit herewith, for publication in the series of Professional Papers, the results of an estimate of the stand and character of the timber of Oregon.

Very respectfully, yours,

HENRY GANNETT,
Geographer.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

THE FORESTS OF OREGON.

By HENRY GANNETT.

In the Nineteenth Annual Report there was published an estimate of the standing timber in Oregon, which was based upon cruisings made by the Oregon and California Railroad Company, the Willamette Valley and Cascade Range Wagon Road Company, and by lumbermen. Since that time a large amount of additional information concerning the forests of the State has been obtained, in part by detailed examinations made by Messrs. J. B. Leiberg, H. D. Langille, F. G. Plummer, Arthur Dodwell, and T. F. Rixon, of the areas lying between latitudes 42° and 43° and longitudes 121° and 123° and the Cascade Range Forest Reserve, in part through reconnaissances made by the Northern Pacific Railroad Company, but mainly through examinations made by Mr. A. J. Johnson, of Astoria, Oreg., in the employ of this office as a special forest expert. Mr. Johnson has been employed upon this work the greater part of two years. He was supplied with all the information at hand concerning the timber lands of the State, and armed with this he has visited nearly every timbered township in the State, making personal examinations, and obtaining information from all reliable sources. With the exception of the areas above noted, the following figures and descriptions are based mainly upon Mr. Johnson's work, supplemented in certain places by the other data above mentioned.

CLASSIFICATION OF LANDS.

The land-classification map of the State herewith presented as Pl. I (in pocket) is also made up mainly from Mr. Johnson's work, supplemented from the work of Messrs. Leiberg, Langille, Plummer, Dodwell, and Rixon in the Cascade Range Forest Reserve and in the areas between latitudes 42° and 43° and longitudes 121° and 123°.

The area of Oregon is 96,030 square miles, of which 1,470 square miles are estimated as water surface, consisting of lakes, rivers, etc., leaving 94,560 square miles as land surface. Of this area, 28,843 square miles, or 30 per cent, are covered with

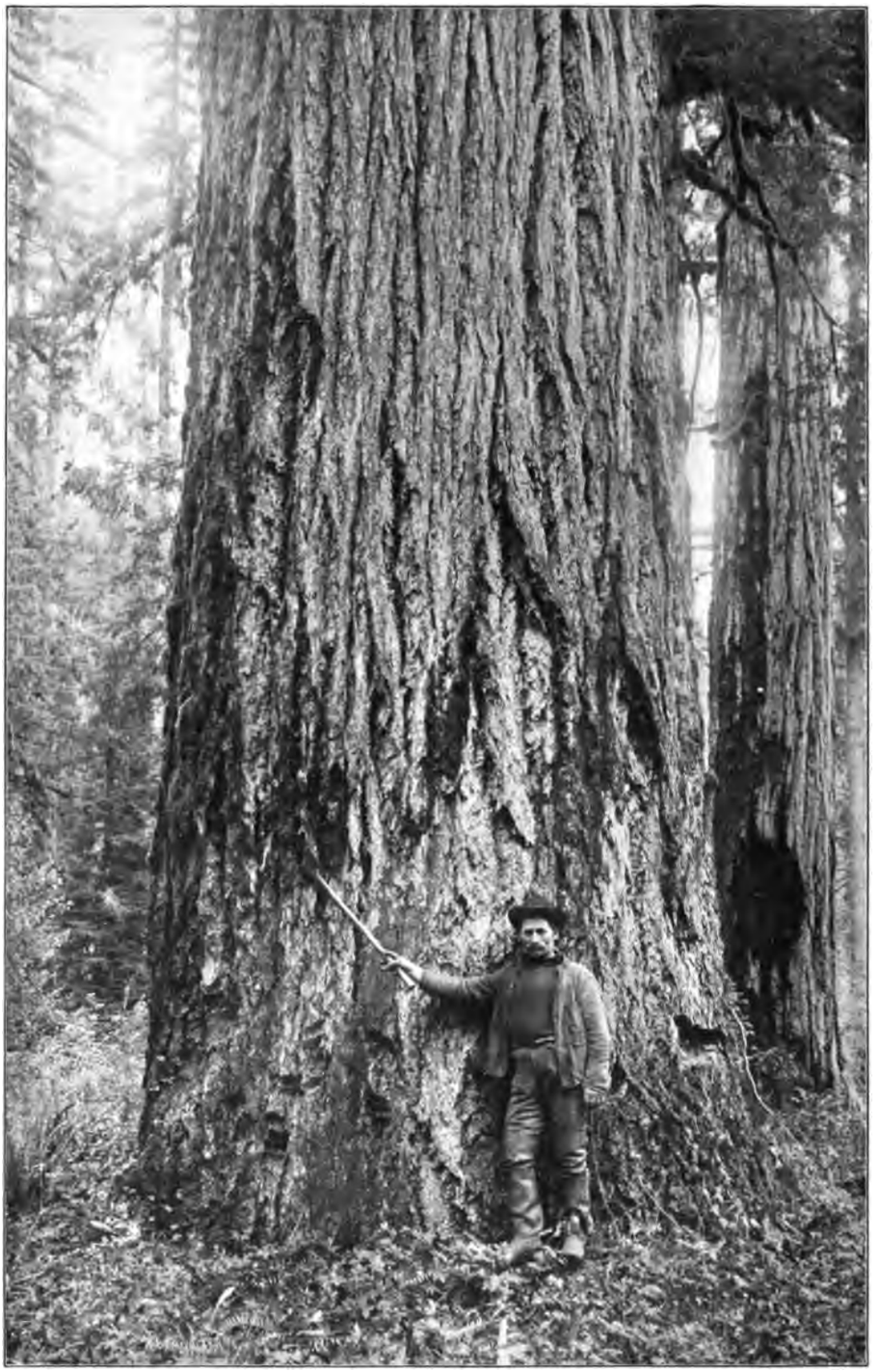
timber of merchantable size and quality; 40,228 square miles, or 43 per cent, are wooded, including in this the area of merchantable timber; 51,980 square miles, or 55 per cent, are at present open country, including the areas which were open before the settlement by whites and those which have been cleared by settlement; the remainder of the State consists of rocky and desert country in the Cascade Range and in the plateaus to the east.

The Coast Range presents an almost unbroken wooded region extending from the Columbia to the south boundary of the State. Toward the south boundary, however, the forests become more open, the southern slopes of the mountains being largely without timber, while, as a rule, the northern slopes are well forested. The great burned areas in the Coast Range are, in the main, well advanced toward restocking with timber. Succeeding this region on the east is a depression extending from Columbia River south to the Siskiyou Mountains, which consists in large part of open country. The northern portion of it consists of the Willamette Valley, beyond which to the southward succeed the valleys of Umpqua and Rogue rivers. The valley of the Willamette is a broad open expanse. How much of this valley was originally forested and has been cleared by man it is impossible at this time to say, but probably strips of considerable width on either side were formerly forested and have thus been cleared. The valleys of Umpqua and Rogue rivers contain much open land, in which are scattered bodies of timber.

The Cascade Range is heavily timbered from the west base to its crest and to a varying distance upon the eastern side. As in the Coast Range, the forest is less dense in the southern part of the State, and to a large extent is confined to the northern slopes. From the crest the forest extends eastward to varying distances, the distance being greatest in the southern part of the State, in Klamath and Lake counties, nearly all of the former county being covered by forests of yellow pine.

In the northeastern part of the State is a large, irregular, isolated body of timber covering the Blue and Wallowa mountains. These forests are open and light as compared with those in the western part of the State.

The crest of the Cascade Range is a natural dividing line between two very different portions of Oregon. West of this line the rainfall is heavy, and consequently the forests are, as a whole, dense, and in parts extremely luxuriant. East of that boundary the rainfall is light, the forests are comparatively scanty and open, and the stand of timber is small. The total area of that part of the State west of the crest of the range is 28,877 square miles, of which 15,089 square miles, or 52 per cent, are occupied by merchantable timber, and 7,102 square miles, or 24 per cent, are open country. As a contrast to this the eastern part of the State comprises 65,683 square miles, of which 13,754 square miles, or only 21 per cent, are timbered, and 44,878 square miles, or 68 per cent, are open country.



RED FIR IN COLUMBIA COUNTY, OREG.

The following table classifies the land west and east of the crest of the Cascade Range, and of the State as a whole:

Classification of lands in Oregon.

Class.	West of Cascades.	East of Cascades.	The State.
	Square miles.	*Square miles.*	*Square miles.*
Total area	28,877	65,683	94,560
Merchantable-timber area	15,089	13,754	28,843
Open country	7,102	44,878	51,980
Burned area	5,159	936	6,095
Cut area	799	280	1,079
Barren	359	1,983	2,352

The area given as cut over is necessarily only a small portion of that actually cleared, inasmuch as many hundreds of square miles were cleared long ago, are now under cultivation, and are here included in the open country.

FIRES.

The most startling feature shown by the land-classification map of this State is the extent of the burned areas, especially in the Coast Range and in the northern half of the Cascades. It must be understood that the areas represented here as burned are only those in which the destruction of timber was nearly or quite complete. Areas which have been burned over with only a partial destruction of the timber are not here represented. It will be noted that the burns are greatest and most frequent in the most moist and most heavily timbered parts of the State, and are smaller and fewer where the rainfall is less and where the timber is lighter. This is owing to the density and abundance of the undergrowth in the heavily forested regions, which feeds the fire and vastly increases its heat. In the comparatively sparsely timbered southern portions of the Coast Range and the Cascades and in the Blue Mountains, where the forests are largely or mainly of yellow pine in open growth, with very little litter or underbrush, destructive fires have been few and small, although throughout these regions there are few trees which are not marked by fire, without, however, doing them any serious damage.

The areas here represented as burned comprise altogether not less than 6,095 square miles, or 7 per cent of the area of the State. Since these burned areas are almost invariably taken from the area formerly timbered, their area may be compared with the timbered area. Out of a total area at one time timbered, not less than 18 per cent, therefore, has been destroyed by fire. Of the amount of the destruction of timber by this agency we may make some estimate, since it is roughly proportional to the amount of land over which the fires have run.

The present stand of timber in the western portion of the State being approximately 154,713 million feet, and the burned area being about one-third of the timbered area, the destruction of timber by fire in this part of the State has been approximately 51,000 million feet. Similarly it appears that in the eastern part of the State the destruction amounts to about 3,000 million feet, a total of 54,000 million feet in the State. This at $1 per 1,000 feet, the present average stumpage price, gives a total loss by fire of $54,000,000. This is a high price to pay for carelessness. The destruction has been even greater here than in Washington, where, as was estimated, 40,000 million feet have been destroyed in a similar manner.

Since this region, especially that portion of it west of the Cascades, where the great burns have occurred, is abundantly watered, and in all other respects extremely favorable for tree growth, all of these burns are in some stage of reforesting, and in most of them reforesting has gone forward rapidly and very favorably. Much of this burned country is now covered with a dense stand of young trees. The species following the fires are, in nearly all cases, similar to those destroyed. Fir follows fir, yellow pine follows yellow pine. There is traceable, however, in the southern part of the State, a tendency toward an extension of the territory of the yellow and sugar pines, with a corresponding reduction of the fir areas. East of the crest of the Cascades some areas formerly occupied by yellow pine have been restocked by lodgepole pine. As a rule, however, even east of the Cascades, the same species succeed, and in this region it is almost invariably yellow pine, since that is the prevailing tree.

In some cases, however, and especially in the largest burns, the work of reforestation has made little progress, owing probably to the difficulty of reseeding large burned areas. Since over many square miles all the trees were killed, the seeds of a new crop have had to come from outside the region, and hence the seeding process has been slow. Areas are reported which were burned twenty-five to fifty years ago on which there is no vegetation larger than brush and ferns, trees of any species not yet having obtained a foothold.

The earliest burns in the State of which we have record occurred in 1843. From that time down to the present fires of greater or less magnitude have occurred yearly, mainly in the late summer and early fall, when everything is driest. The greatest fires, however, seem to have occurred prior to and during the earliest settlements, between 1843 and 1870. Apparently the fires in recent years have not been as great or as disastrous as these earlier ones.

It is said that the burn between the forks of Coquille River, in the southwestern part of the State, occurred in 1843, and that after a lapse of twenty-five years, during which the region had made much progress in reforesting, a second fire occurred in the same region, in 1868. Since this latter fire the area has made great progress

A. THE GREAT NESTUCCA BURN.

B. THE GREAT YAQUINA BURN.

toward reforestation. In 1846 occurred two of the great burns in the Coast Range, the Yaquina burn and that extending along the coast from Cape Perpetua to Siuslaw River. The Yaquina burn extended north and south over four townships, and from the coast across to Willamette Valley, an area of 450,000 acres. It is said to have been set by Hudson Bay trappers for the purpose of driving out game. In this purpose it was certainly effective, as it is said that all the game of the region which was not immediately destroyed by the fire was driven to the seashore. In this great region it is reported that there has been little regrowth, the ground being covered with blackberry vines and ferns, in which still stand in many places dead and charred tree trunks.

The other large area burned in 1846 included 207,000 acres, embracing three townships north and south by an equal number east and west.

Heavy fires are reported to have occurred in 1848 and 1850, while between 1850 and 1860, the exact date unknown, occurred the great Nestucca burn, which included most of townships 3, 4, and 5 south, and extended east and west across the entire breadth of the Coast Range, comprising an area of nearly 500 square miles.

The year 1868 is known as the year in which the whole coast was afire, the year in which the sun was darkened for weeks and the people had to burn candles in the daytime. In this year occurred the great burn extending from Coos Bay southward along the coast to Rogue River Mountains. In this year also the area between the forks of Coquille River was reburned.

The great burn in the northern part of the Cascade Range, extending from the Willamette base line southward to township 11, appears to be a composite affair, composed of many different burns overlapping one another. The earliest and largest of them, however, is by common repute assigned a great age. Fires are reported in this region as early as 1860–61, and at various times since then.

STAND OF TIMBER.

The timber of Oregon is, in density and quality, closely comparable with that of Washington, and over most of the area the species of trees are very nearly the same.

The total stand of timber in the State is estimated at 213,398 million feet B. M., an average stand per acre of timbered land of 12,200 feet. The stand, however, as in Washington, differs widely in different parts of the State. West of the crest of the Cascades the total stand of timber is estimated at 171,780 million. Thus 80 per cent of the total timber of the State is found in a region which is 30 per cent of the total area of the State. The average stand of timber upon the timbered land of this region is not less than 17,700 feet per acre.

The total stand of timber upon the area east of the Cascades is only 41,618 million, and the average stand per acre is 4,700 feet.

SPECIES OF TIMBER.

Not only do these two sections of the State differ widely in the extent of their forests, but they differ also in species.

Of the timber of Oregon, red fir constitutes not less than 66 per cent, a proportion somewhat larger than in Washington. Pine, including yellow and sugar pine, constitutes 18 per cent, a proportion much larger than in Washington. Spruce constitutes 5 per cent, the same as in Washington; hemlock 5 per cent and cedar only 2 per cent, being much less than in the more northern State.

In the western part of the State red fir forms 79 per cent of the forest, and the only other component of magnitude is the Sitka spruce, other species being of little relative importance. Yellow pine constitutes but 2 per cent. East of the crest, on the other hand, yellow pine forms 80 per cent of the forest, with red fir holding second rank.

Fir forms practically a pure forest on either side of Willamette and Rogue River valleys, including the eastern slopes of the Coast Range and the lower portion of the west slope of the Cascade Range. This species shares the western part of the Coast Range with the Sitka spruce and cedar, while in the higher parts of the Cascade Range other species of fir and cedar are found. The southern part of this region west of the Cascade crest contains much yellow and sugar pine.

Sitka spruce is found in a narrow strip hugging the Pacific coast, a region of continual fogs and moisture. It is here mingled with cedar, hemlock, and fir.

Yellow pine forms pure or nearly pure forest over all the timbered area east of the Cascade Range. It crosses the range near Crater Lake, and spreads over the Umpqua and Rogue River valleys and the Coast Range in a mixed forest with fir and sugar pine.

Sugar pine occupies an area in the southwestern part of the State on both sides of the Cascade Range, where it is mixed with yellow pine and fir.

Two small tracts of redwood, comprising about 400 acres, are found in the southwest corner of the State, in T. 39 S., R. 12 W., and T. 40 S., R. 13 W. These are the most northern occurrences of these species.

The following tables show the total stand and its classification by species in the State as a whole, and the same in the eastern and western parts of the State:

Composition of forest in Oregon.

Species.	West of Cascades.		East of Cascades.		Total.	
	Million feet B. M.	*Per cent.*	*Million feet B. M.*	*Per cent.*	*Million feet B. M.*	*Per cent.*
Red fir	136,543	79	4,762	11	141,305	66
Yellow pine	3,886	2	33,254	80	37,140	17
Sitka spruce	8,915	5	.....	.....	8,915	5
Red cedar	4,547	3	.....	.....	4,547	2
Hemlock	8,887	5	1,082	3	9,969	5
White cedar	2,652	2	.....	.....	2,652	1
Noble fir	2,355	1	454	1	2,809	1
Sugar pine	1,648	1	341	1	1,989	1
White fir	723	2	704	2	1,427	2
Tamarack	.....		704	2	704	
White pine	287		175	.....	462	
Incense cedar	208		53	.....	261	
Engelmann spruce	29		89	.....	118	
Lovely fir	1,100		.....	.....	1,100	
Total	171,780	.....	41,618	.....	213,398	.....

CLASSIFICATION OF LANDS AND STAND OF TIMBER, BY COUNTIES.

The following table summarizes the total stand of timber and the average stand per acre of timbered land in each county.

Total stand of timber and stand per acre in Oregon, by counties.

County.	Stand.	Average stand per acre.
	Million feet B.M.	*Feet B. M.*
Baker	3,084	8,100
Benton	1,839	12,600
Clackamas	8,516	25,200
Clatsop	16,736	37,400
Columbia	9,841	31,200
Coos	13,557	24,500
Crook	7,577	4,800
Curry	5,466	11,000
Douglas	21,156	13,200
Grant	2,370	2,800
Harney	336	1,300
Jackson	10,327	10,000
Josephine	3,616	6,000
Klamath	11,822	5,500
Lake	3,106	3,000

Total stand of timber and stand per acre in Oregon, by counties—Continued.

County.	Stand.	Average stand per acre.
	Million feet B. M.	*Feet B. M.*
Lane	34,006	17,900
Lincoln	6,881	30,300
Linn	9,433	12,300
Malheur	130	2,100
Marion	3,351	11,900
Morrow	147	1,435
Multnomah	1,915	29,300
Polk	4,454	22,900
Tillamook	16,861	39,500
Umatilla	257	4,800
Union	3,273	3,800
Wallowa	3,304	4,700
Wasco	5,988	17,600
Washington	2,628	16,200
Wheeler	359	800
Yamhill	1,062	16,400

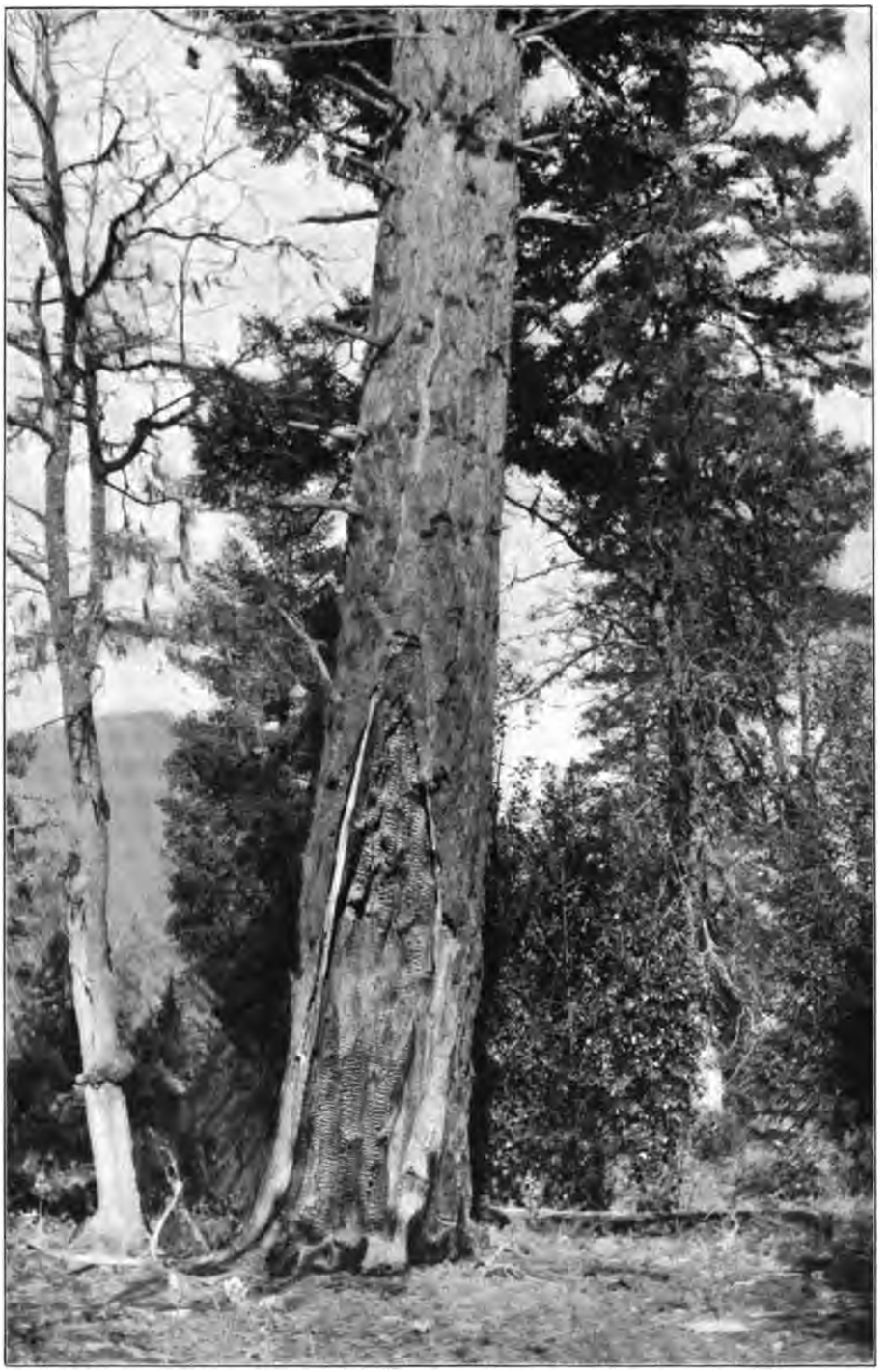
The heaviest average stand per county is in Tillamook, on the coast. Other coast counties show very heavy stands, particularly Clatsop and Lincoln. Generally speaking, the counties in the Coast Range have the heaviest stands in the State, with those on the west slope of the Cascade Range as second to them in stand. Compared with those farther south, the counties bordering on Columbia River have the heavier stands, as in Columbia and Multnomah.

BAKER COUNTY.

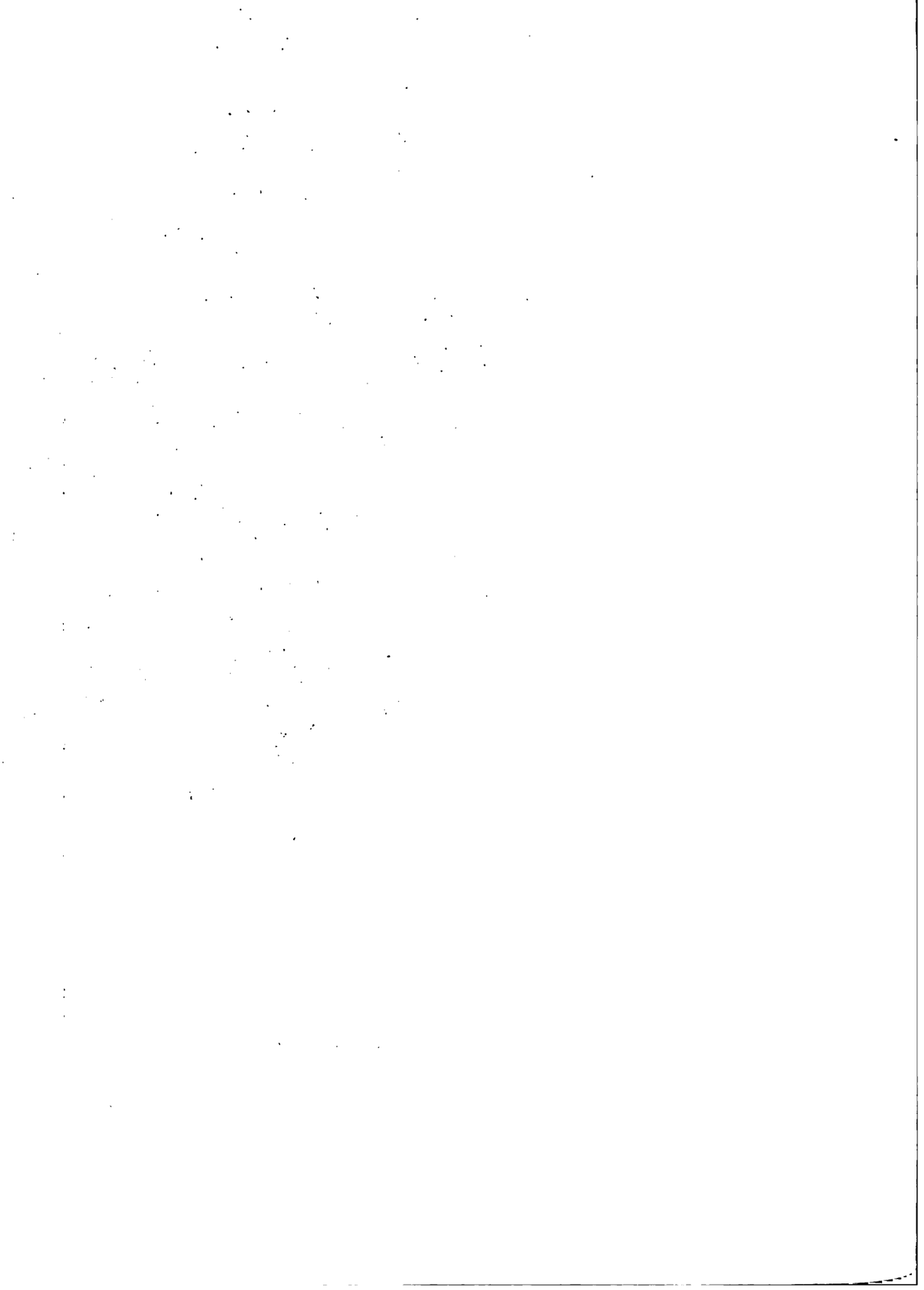
This county lies in the eastern part of the State. Most of its area is comprised in the valley of Powder River and the Snake, and is composed of level country and low hills. The western part forms the eastern slope of the Blue Mountains, which rise to altitudes of 9,000 feet. The slopes of this range contain some merchantable timber, in which considerable cutting has been done for the supply of mines and the building of Baker City, the county seat.

Classification of lands in Baker County.

	Square miles.
Total area	2,275
Merchantable-timber area	595
Woodland	96
Cut lands	120
Open country	1,400
Barren	64



RED FIR, SHOWING RESULT OF FOREST FIRE.



Amount and classification of timber in Baker County.

	Million feet B. M.
Yellow pine	2,960
Tamarack	62
Red fir	62
Total	3,084

Average stand of timber per acre of timbered land, 8,100 feet B. M.

BENTON COUNTY.

This county lies in the western part of the State, being comprised in part in the valley of Willamette River and in part in the Coast Range, of which it occupies a portion of the eastern slope. The eastern, valley part of the county is mainly open and occupied by farms, with timber in small patches scattered over it. The western, hill portion is in part covered with merchantable timber. Another portion of what was formerly covered with merchantable timber has been cut, and a third part has been burned, being included within the great Yaquina burn.

Classification of lands in Benton County.

	Square miles.
Total area	677
Merchantable-timber area	228
Cut area	119
Burned area	88
Open country	242

Amount and classification of timber in Benton County.

	Million feet B. M.
Red fir	1,728
Spruce	74
Cedar	37
Total	1,839

Average stand of timber per acre of timbered land, 12,600 feet B. M.

CLACKAMAS COUNTY.

This county is in the northwestern part of the State, the western portion extending down to the middle of the Willamette Valley, while its boundary on the east is the crest of the Cascade Range. The western, valley portion is open and is largely occupied by farms, with which are interspersed groves and patches of woodland. Much the larger part of the county, however, lies on the west slopes of the Cascade Range, and contains considerable areas of merchantable timber, together with several large burned areas; indeed, the burned areas comprise nearly one-half of the area of the county.

Classification of lands in Clackamas County.

	Square miles.
Total area	1,861
Merchantable-timber area	528
Cut area	38
Burned area	886
Open country	401
Barren	8

Amount and classification of timber in Clackamas County.

	Million feet B. M.
Red fir	7,986
Noble fir	265
Red cedar	177
White pine	88
Total	8,516

Average stand of timber per acre of timbered land, 25,200 feet B. M.

CLATSOP COUNTY.

This is the most northwestern county of the State, bordering on Columbia River at its mouth and the Pacific Ocean. Its area is comprised entirely in the Coast Range. The forests are extremely dense and heavy, and, compared with the area of the county, but little cutting has been done, and the burned areas, although numerous, are small and collectively amount to less than 5 per cent of the area of the county.

Classification of lands in Clatsop County.

	Square miles.
Total area	820
Merchantable-timber area	698
Cut area	32
Burned area	40
Open country	2
Barren	48

Amount and classification of timber in Clatsop County.

	Million feet B. M.
Red fir	10,543
Spruce	3,683
Hemlock	1,506
Cedar	1,004
Total	16,736

Average stand of timber per acre of timbered land, 37,400 feet B. M.

COLUMBIA COUNTY.

This county lies east of Clatsop, bordering on Columbia River on the north and east. It is a hilly county, comprising a portion of the Coast Range, and is largely covered with merchantable timber. Numerous small areas have been burned, amounting collectively to a little more than 10 per cent of its area, and some cutting has been done.

Classification of lands in Columbia County.

	Square miles.
Total area	677
Merchantable-timber area	493
Cut area	56
Burned area	80
Barren	48

Amount and classification of timber in Columbia County.

	Million feet B. M.
Red fir	8,561
Cedar	1,083
Hemlock	197
Total	9,841

Average stand of timber per acre of timbered land, 31,200 feet B. M.

COOS COUNTY.

This county borders on the Pacific Ocean, in the southwestern part of the State, and includes upon the east a considerable part of the Coast Range. Much of the western portion of the county is low and marshy, and contains many small open areas. Burns have in time past been frequent, and have destroyed the timber upon more than one-fourth of the area of the county. Most of them are of great age, having occurred more that fifty years ago, and the tracts are now in great part restocked with young timber. Some cutting has been done, especially in the neighborhood of Coos Bay.

Classification of lands in Coos County.

	Square miles.
Total area	1,578
Merchantable-timber area	866
Burned area	424
Open country	248
Barren	40

Amount and classification of timber in Coos County.

	Million feet B. M.
Red fir	10,168
White cedar	2,033
Spruce	1,356
Total	13,557

Average stand of timber per acre of timbered land, 24,500 feet B. M.

CROOK COUNTY.

This large county lies in the central part of the State, its western portion extending to the crest of the Cascade Range, whence it stretches far out into the plateau to the east. It contains a large body of timber and woodland upon the east slope of the range, and this body of timber stretches out onto the plateau far to the east of the mountains. Besides this main body of timber there are several others in the eastern part of the county. The timber consists almost exclusively of yellow pine.

Classification of lands in Crook County.

	Square miles.
Total area	7,756
Merchantable-timber area	2,466
Woodland	799
Burned area	216
Open country	4,020
Barren	255

Amount and classification of timber in Crook County.

	Million feet B. M.
Yellow pine	7,483
Red fir	94
Total	7,577

Average stand of timber per acre of timbered land 4,800 feet B. M.

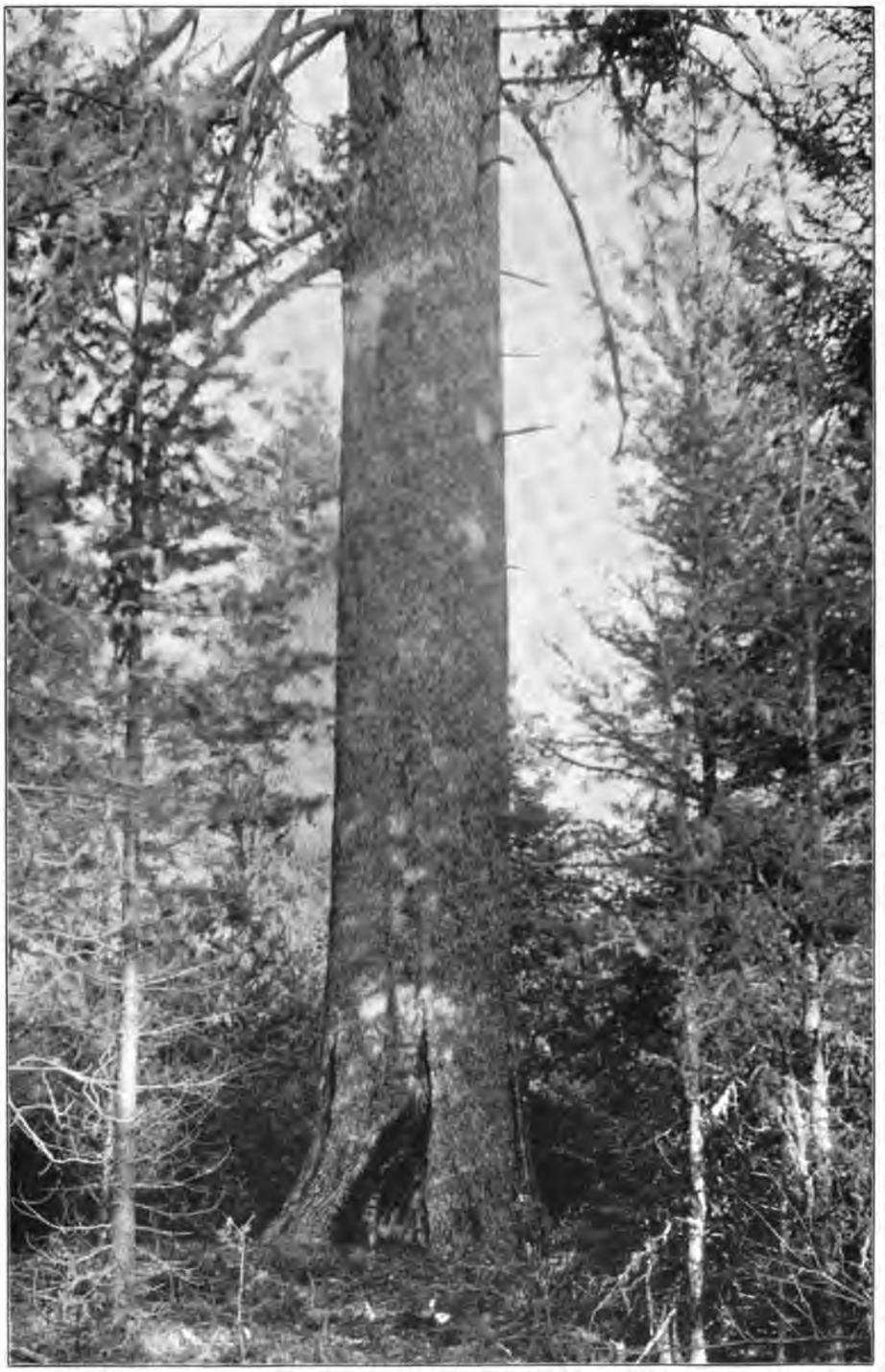
CURRY COUNTY.

This is the most southwestern county of the State, bordering upon the Pacific Ocean and the California line. Near the coast is a strip of open country, and in the eastern part of the county the timber becomes somewhat scattering, especially upon the south slopes of the mountains. There has been no cutting of any consequence in the county, but the northern part has been badly burned.

In the southwestern part of the county, in T. 39 S., R. 12 W., and T. 40 S., R. 13 W., there are small tracts, aggregating about 400 acres, of redwood, the sole representatives of this species in the State, and the most northern extension of the species.

Classification of lands in Curry County.

	Square miles.
Total area	1,454
Merchantable-timber area	782
Burned area	272
Open country	384
Barren	16



SUGAR PINE, SHOWING RESULT OF FOREST FIRE.

Amount and classification of timber in Curry County.

	Million feet B. M.
Red fir	4,810
White cedar	547
Sugar pine	109
Total	5,466

Average stand of timber per acre of timbered land, 11,000 feet B. M.

DOUGLAS COUNTY.

This large county stretches northwestward from the crest of the Cascades to the coast, including the valley of Umpqua River. It is heavily timbered in the east and west—that is, in the Cascade and Coast ranges—while the central portion is largely composed of open country, dotted with farms alternating with patches of timber. The eastern portion of the county, in the Cascade Range, contains several burns, but none of great magnitude; the western portion, near the Pacific coast, was in large part burned many years ago and is now covered with a young growth of timber.

Classification of lands in Douglas County.

	Square miles.
Total area	4,861
Merchantable-timber area	2,513
Woodland	341
Burned area	531
Cut area	20
Open country	1,428
Barren	28

Amount and classification of timber in Douglas County.

	Million feet B. M.
Red fir	17,485
Hemlock	3,014
Sugar pine	263
Yellow pine	263
Red cedar	131
Total	21,156

Average stand of timber per acre of timbered land, 13,200 feet B. M.

GILLIAM COUNTY.

This is one of the northern counties of the State, east of the Cascade Range, bordering on the north on Columbia River. The county has an area of 1,123 square miles. It contains no timber whatever.

GRANT COUNTY.

This county lies toward the eastern part of the State, adjoining Baker County on the east. It includes the western slopes of the Blue Mountains, with the long spurs running westward from them, and contains considerable timbered and wooded land, in very irregular form.

Classification of lands in Grant County.

	Square miles.
Total area	4,560
Merchantable-timber area	1,308
Woodland	749
Open country	2,419
Barren	84

Total stand of timber in this county is 2,370 million feet, all of which is yellow pine.
Average stand per acre of timbered land, 2,800 feet B. M.

HARNEY COUNTY.

This large county lies toward the southeastern part of the State. Its surface is mainly level or undulating, but is intersected by several ranges of mountains and hills, such as Steins Mountain, in the southwestern part. The only timber contained in the county is toward its northern edge, where a range of hills bears scattering pines.

Classification of lands in Harney County.

	Square miles.
Total area	9,986
Merchantable-timber area	400
Open country	9,586

Total stand in this county is 336 million feet B. M., all of which is yellow pine.
Average stand per acre of timbered land, 1,300 feet B. M.

JACKSON COUNTY.

This county is situated in the southwestern part of the State, bordering the California line on the south, and extending on the east to the crest of the Cascade Range. The western part of the county is largely open country, dotted with farms and with patches of timber, while the eastern part, in the Cascade Range, and the southern part, in the Siskiyou Mountains, are timbered, but not heavily, with a mixed growth of yellow and sugar pines, red fir, and other species. There are many burned areas in the western part of the county, but they do not cover a great area, but little more than 5 per cent of the area of the county having been included in destructive fires.

Classification of lands in Jackson County.

	Square miles.
Total area	2,721
Merchantable-timber area	1,682
Burned area	146
Open country	874
Barren	19

Amount and classification of timber in Jackson County.

	Million feet B. M.
Yellow pine	2,375
Sugar pine	516
White pine	116
Red fir	5,679
White fir	723
Noble fir	619
Incense cedar	63
Hemlock	207
Engelmann spruce	29
Total	10,327

Average stand of timber per acre of timbered land, 10,000 feet B. M.

JOSEPHINE COUNTY.

This county lies west of Jackson and extends on the south to the California line. Most of the area of the county is included in the Coast Range, and bears a scattered light growth of timber composed mainly of fir and yellow and sugar pine. A considerable part of this county has been cut over.

Classification of lands in Josephine County.

	Square miles.
Total area	1,684
Merchantable-timber area	930
Cut area	200
Open country	554

Amount and classification of timber in Josephine County.

	Million feet B. M.
Red fir	1,591
Yellow pine	1,012
Sugar pine	760
Incense cedar	145
White cedar	72
Noble fir	36
Total	3,616

Average stand of timber per acre of timbered land, 6,000 feet B. M.

KLAMATH COUNTY.

This county lies in the southern part of the State, bordering on the south upon California, its eastern boundary being the divide of the Cascade Range. The western part of the county is mountainous, while the central and eastern parts are plains and valleys, intersected by narrow mountain ranges or occupied by lakes. Much more than two-thirds of the area of this county is wooded, and more than one-half is covered with merchantable forests. The forests cover the eastern slope of the range, while in the rest of the county open and timbered tracts alternate irregularly.

Classification of lands in Klamath County.

	Square miles.
Total area	5,854
Merchantable-timber area	3,329
Woodland	837
Burned area	132
Open country	1,503
Barren	53

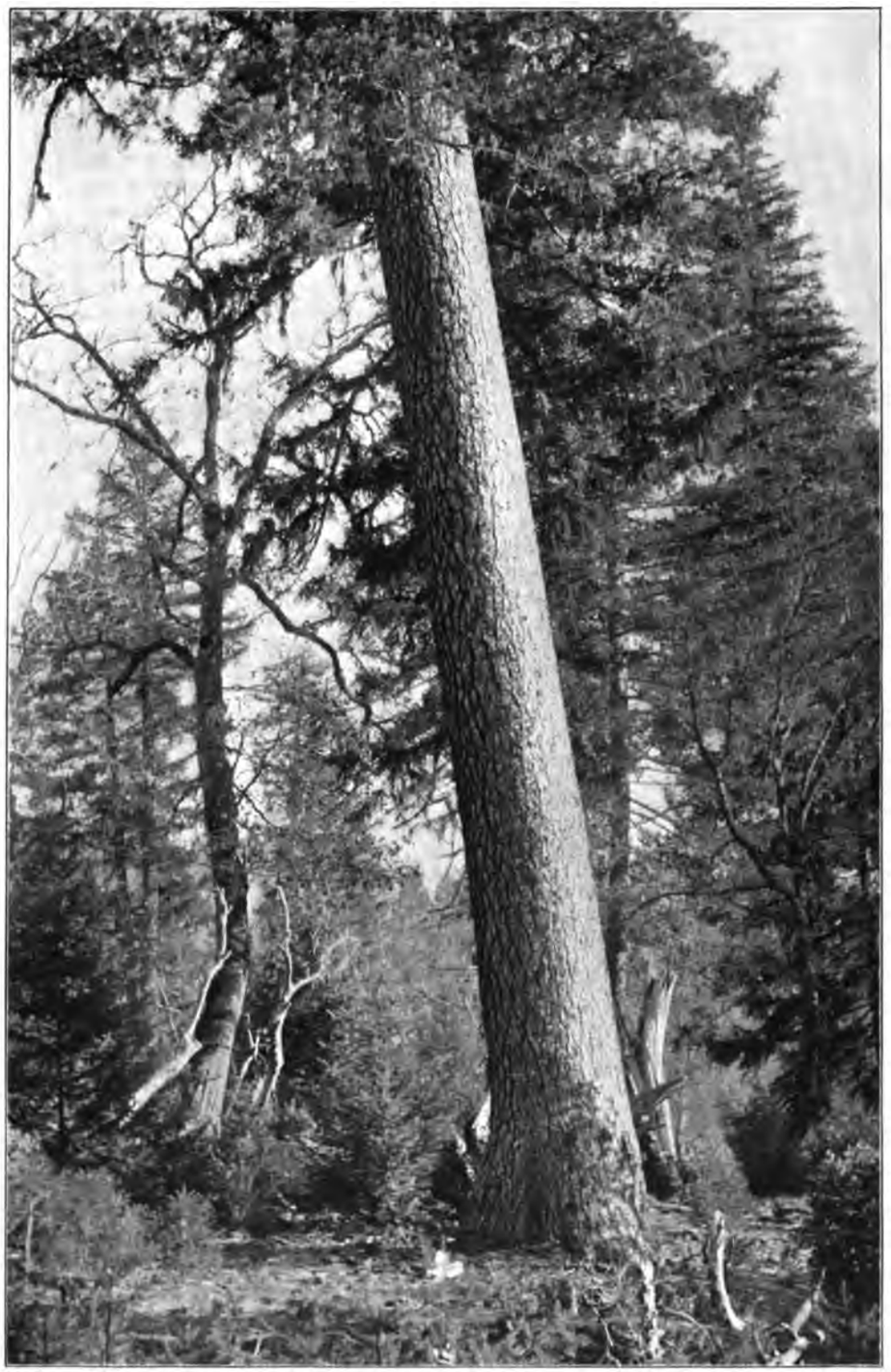
Amount and classification of timber in Klamath County.

	Million feet B. M.
Yellow pine	8,532
Sugar pine	341
White pine	85
Red fir	1,024
White fir	569
Noble fir	228
Incense cedar	53
Hemlock	901
Engelmann spruce	89
Total	11,822

Average stand of timber per acre of timbered land, 5,500 feet B. M.

LAKE COUNTY.

This county lies east of Klamath, bordering on California and Nevada on the south. The only timber in the county is found in its western portion, where it joins the great bodies which stretch over from Klamath County. Its surface is mainly a plateau, intersected by several narrow mountain ranges, and in the northern part by a great flow of lava, which has all the aspects of a desert.



SUGAR PINE 10 FEET IN DIAMETER.

Classification of lands in Lake County.

	Square miles.
Total area	7,834
Merchantable-timber area	1,624
Woodland	120
Open country	4,956
Barren	1,134

Total stand of timber is 3,106 million feet B. M., all of which is yellow pine.

Average stand of timber per acre of timbered land, 3,000 feet B. M.

LANE COUNTY.

This county stretches from the crest of the Cascade Range westward to the coast, in its central portion intersecting the open valley of Willamette River. This valley is largely occupied by farms, alternating with patches of timber. The eastern and western portions of the county are heavily forested, and especially the portion within the Cascade Range, where, although there are several burns of magnitude, there is a vast extent of heavy forest. In the Coast Range, the portion bordering upon the coast, with a breadth equivalent to three townships eastward, is included in one of the great coast burns.

Classification of lands in Lane County.

	Square miles.
Total area	4,380
Merchantable-timber area	2,956
Cut area	33
Burned area	801
Open country	531
Barren	59

Amount and classification of timber in Lane County.

	Million feet B. M.
Red fir	27,827
Red cedar	471
Yellow pine	236
Noble fir	636
Hemlock	3,736
Lovely fir	1,100
Total	34,006

Average stand of timber per acre of timbered land, 17,900 feet B. M.

LINCOLN COUNTY.

This county lies along the Pacific coast, toward the northern part of the State, stretching from the coast back into the Coast Range. Upon three-fifths of its area the timber has been destroyed by fire, mainly by the great Yaquina burn, most of the area of which is included within this county.

Classification of lands in Lincoln County.

	Square miles.
Total area	1,008
Merchantable-timber area	354
Burned area	598
Open country	17
Barren	39

Amount and classification of timber in Lincoln County.

	Million feet B. M.
Red fir	4,679
Spruce	1,927
Cedar	275
Total	6,881

Average stand of timber per acre of timbered land, 30,300 feet B. M.

LINN COUNTY.

This county stretches from the summit of the Cascade Range westward to Willamette River, the western part of it being included within the valley of that stream, and consisting of open farming country alternating with patches of timber. The eastern portion, comprising about two-thirds of the county, lies in the Cascade Range and is in the main heavily timbered, although several large burns have reduced the timbered area.

Classification of lands in Linn County.

	Square miles.
Total area	2,311
Merchantable-timber area	1,193
Burned area	345
Open country	767
Barren	6

Amount and classification of timber in Linn County.

	Million feet B. M.
Red fir	8,843
Noble fir	393
Red cedar	197
Total	9,433

Average stand of timber per acre of timbered land, 12,300 feet B. M.

MALHEUR COUNTY.

This county is in the southeast corner of the State. It is comprised entirely in a semidesert plateau region, and presents, in the main, a level surface, traversed here and there by narrow ranges. The only timber in the county is in its northwest corner, where a little stretches over from the Blue Mountains.

Classification of lands in Malheur County.

	Square miles.
Total area	9,784
Merchantable-timber area	96
Open country	9,688

Total stand of timber is 130 million feet B. M., all of which is yellow pine.

Average stand of timber per acre of timbered land, 2,100 feet B. M.

MARION COUNTY.

This county is situated toward the northwestern part of the State, and stretches from the crest of the Cascade Range westward to Willamette River. That portion of it lying within the valley of the Willamette is largely occupied by farms, and consists of open country alternating with patches of timber. The mountainous portion of the county has been badly burned, but still contains a considerable area of merchantable timber.

Classification of lands in Marion County.

	Square miles.
Total area	1,170
Merchantable-timber area	439
Burned area	236
Open country	491
Barren	4

Amount and classification of timber in Marion County.

	Million feet B. M.
Red fir	3,102
Noble fir	83
White pine	83
Red cedar	83
Total	3,351

Average stand of timber per acre of timbered land, 11,900 feet B. M.

MORROW COUNTY.

This is one of the northern counties of the State, bordering on the north on Columbia River. Its surface is mainly level or undulating, rising in the south into hills which may be regarded as westward spurs from the Blue Mountains. The only timber in the county is in these hills, in the southern part, and consists almost entirely of yellow pine in scattering stands.

Classification of lands in Morrow County.

	Square miles.
Total area	2,021
Merchantable-timber area	160
Woodland	98
Open country	1,763

Total stand of timber is 147 million feet B. M., all of which is yellow pine.

Average stand of timber per acre of timbered land, 1,435 feet B. M.

MULTNOMAH COUNTY.

This county lies in the western part of the State, west of the Cascade Range, and borders on Columbia River. Eastward it stretches far up the slopes of the range, but does not reach its summit. The timber has been cut from nearly one-half of this county, and the timbered area still remaining is nearly one-fourth of its total area.

Classification of lands in Multnomah County.

	Square miles.
Total area	429
Merchantable-timber area	102
Woodland	18
Cut area	207
Burned area	23
Open country	25
Barren	54

Amount and classification of timber in Multnomah County.

	Million feet B. M.
Red fir	1,686
Noble fir	154
Hemlock	58
Red cedar	17
Total	1,915

Average stand of timber per acre of timbered land, 29,300 feet B. M.

POLK COUNTY.

This county lies in the western part of the State, bordering on the east on Willamette River, and stretching westward into the Coast Range. The eastern half of the county lies in an open valley, and is largely occupied by farms, alternating with patches of timber, while the western half is quite heavily forested.

Classification of lands in Polk County.

	Square miles.
Total area	701
Merchantable-timber area	304
Cut area	3
Burned area	10
Open country	384

Amount and classification of timber in Polk County.

	Million feet B. M.
Red fir	4,276
Red cedar	178
Total	4,454

Average stand of timber per acre of timbered land, 22,900 feet B. M.

SHERMAN COUNTY.

This is one of the northern counties, bordering on the north upon Columbia River. It has an area of 736 square miles. It contains no timber whatever.

TILLAMOOK COUNTY.

This is a northwestern county, bordering upon the Pacific, and lying immediately south of Clatsop. Most of its area is included within the western slopes of the Coast Range. It was originally one of the most heavily timbered areas in the Northwest, and still contains a large amount of timber, although the timber in much of its area was destroyed many years ago by the great Nestucca burn.

Classification of lands in Tillamook County.

	Square miles.
Total area	1,119
Merchantable-timber area	667
Cut area	18
Burned area	361
Open country	73

Amount and classification of timber in Tillamook County.

	Million feet B. M.
Red fir	13,995
Spruce	1,854
Cedar	674
Noble fir	169
Hemlock	169
Total	16,861

Average stand of timber per acre of timbered land, 39,500 feet B. M.

UMATILLA COUNTY.

This county lies in the northeastern part of the State, bordering on the north on Washington. The northwestern part of the county consists of an undulating country, without timber, while the southeastern part contains a portion of the Blue Mountains and is covered more or less densely with yellow-pine forests. Considerable cutting has been done along the line of the Oregon Railway and Navigation Company's road.

Classification of lands in Umatilla County.

	Square miles.
Total area	3,116
Merchantable-timber area	84
Woodland	478
Burned area	41
Cut area	83
Open country	2,375
Barren	55

Amount and classification of timber in Umatilla County.

	Million feet B. M.
Yellow pine	252
Tamarack	5
Total	257

Average stand of timber per acre of timbered land, 4,800 feet B. M.

UNION COUNTY.

This county is situated in the northeastern part of the State, bordering Snake River on the east. The southern and western parts consist of open valley country, the valley of Powder River and of the Grande Ronde. The northeastern portion comprises the southern slopes of the Wallowa Mountains, rising 10,000 to 11,000 feet above the sea. These slopes are covered to altitudes of between 8,000 and 9,000 feet with an open pine forest.

Classification of lands in Union County.

	Square miles.
Total area	3,146
Merchantable-timber area	1,324
Woodland	292
Cut area	69
Burned area	95
Open country	1,302
Barren	64

Amount and classification of timber in Union County.

	Million feet B. M.
Yellow pine	2,749
Red fir	262
Tamarack	262
Total	3,273

Average stand of timber per acre of timbered land, 3,800 feet B. M.

WALLOWA COUNTY.

This is the northeastern county of the State, bordering on Snake River and the State of Washington. The northern and southern parts of this county are forested, the former consisting of the Blue Mountains and the latter of the northern slopes of the Wallowa Mountains. The timber consists mainly of yellow pine and is fairly heavy for that class of timber.

Classification of lands in Wallowa County.

	Square miles.
Total area	2,784
Merchantable-timber area	1,093
Burned area	57
Open country	1,464
Barren	170

A. YELLOW PINE, BLUE MOUNTAINS, SHOWING RESULT OF BURN.

B. TAMARACK GROVE, BLUE MOUNTAINS.

[illegible]

	Square miles
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

[illegible] Willamette meridian and [illegible] R. W.

UNION COUNTY.

This county is situated in the northeastern part of the State, bordering Snake River on the east. The southern and western parts consist of open valley country, the valley of Powder River and of the Grande Ronde. The northeastern portion comprises the southern slopes of the Wallowa Mountains, rising 2,000 to 11,000 feet above the sea. These slopes are covered to altitudes of between 5,000 and 8,000 feet with an open pine forest.

[illegible]

	Square miles
Total area	3,146
Merchantable timber area	1,824
Woodland	252
Cut area	80
Burned area	46
Open country	1,092
Barren	64

[illegible]

	Million feet B. M.
Yellow pine	2,749
Red fir	362
Tamarack	262
Total	3,273

Average stand [illegible] per acre of the merchantable land. Log scale, Scribner rule. B. M.

WALLOWA COUNTY.

This is the northeastern county of the State, bordering on Snake River and the State of Washington. The northern and southern parts of this county are forested, the former consisting of the Blue Mountains and the latter of the northern slopes of the Wallowa Mountains. The timber consists mainly of yellow pine and is fairly heavy for that class of timber.

[illegible]

	Square miles
Total area	2,784
Merchantable timber area	1,083
Burned area	57
Open country	1,464
Barren	170

A. YELLOW PINE, BLUE MOUNTAINS SHOWING RESULT OF BURN.

B. TAMARACK GROVE, BLUE MOUNTAINS.

Amount and classification of timber in Wallowa County.

	Million feet B. M.
Yellow pine	2,544
Red fir	430
Tamarack	330
Total	3,304

Average stand of timber per acre of timbered land, 4,700 feet B. M.

WASCO COUNTY.

This is a northern county, bordering on the north on Columbia River, while its western limit is the summit of the Cascade Range. The eastern part of this county, comprising much the larger portion, is open, consisting of the valley of Deschutes River and the slopes leading down to it. The western portion of the county, lying in the Cascade Range, is mountainous and is heavily forested, excepting for one large burn, which includes nearly one-seventh of the entire area of the county.

Classification of lands in Wasco County.

	Square miles.
Total area	2,962
Merchantable-timber area	531
Woodland	295
Cut area	8
Burned area	395
Open country	1,629
Barren	104

Amount and classification of timber in Wasco County.

	Million feet B. M.
Red fir	2,890
Yellow pine	2,286
Noble fir	226
Hemlock	181
Cedar	135
White fir	90
White pine	90
Silver fir	45
Tamarack	45
Total	5,988

Average stand of timber per acre of timbered land, 17,600 feet B. M.

WASHINGTON COUNTY.

This county lies in the northwestern part of the State, bordering on the east upon Columbia River and stretching westward into the Coast Range. Most of the area of the county consists of open country, occupied by farms and small patches of timber. The only merchantable timber is in the northwestern part, and covers a relatively small area.

Classification of lands in Washington County.

	Square miles
Total area	715
Merchantable-timber area	253
Cut area	63
Burned area	68
Open country	331

Amount and classification of timber in Washington County.

	Million feet B. M.
Red fir	2,575
Red cedar	53
Total	2,628

Average stand of timber per acre of timbered land, 16,200 feet B. M.

WHEELER COUNTY.

This is a new county, a little north of the center of the State. Its area consists largely of open country, the valleys of John Day River and its branches, but it is intersected by east and west ranges of hills, which may be regarded as westward spurs from the Blue Mountains, and which contain a scattering growth of yellow pine.

Classification of lands in Wheeler County.

	Square miles.
Area of county	1,746
Merchantable-timber area	744
Woodland	88
Open country	914

Total stand of timber is 359 million feet B. M., all of which is yellow pine.

Average stand of timber per acre of timbered land, 800 feet B. M.

YAMHILL COUNTY.

This county lies in the northwestern part of the State, bordering on the east upon Willamette River and stretching westward into the Coast Range. The eastern part of the county is open and is mainly occupied by farms and patches of timber, while the western portion, which otherwise would be heavily forested, is almost entirely included within the area of the great Nestucca burn. The area of merchantable timber in this county is, in consequence, very small.

Classification of lands in Yamhill County.

	Square miles.
Total area	711
Merchantable-timber area	101
Cut area	10
Burned area	250
Open country	350

Amount and classification of timber in Yamhill County.

	Million feet B. M.
Red fir	1,009
Cedar	32
Spruce	21
Total	1,062

Average stand of timber per acre of timbered land, 16,400 feet B. M.

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Professional Paper No. 5 Series H, Forestry, 2

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

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REPLACEMENT COPY

THE

FORESTS OF WASHINGTON

A REVISION OF ESTIMATES

BY

HENRY GANNETT

WASHINGTON
GOVERNMENT PRINTING OFFICE
1902

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ILLUSTRATION.

PLATE I. Land-classification map of Washington ..... In pocket.

LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., June 17, 1902.

SIR: I transmit herewith, for publication in the series of Professional Papers, a revision of the estimates of the standing timber and its distribution in the State of Washington.

Very respectfully, yours,

HENRY GANNETT,
Geographer.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

THE FORESTS OF WASHINGTON.
(A REVISION OF ESTIMATES.)

By HENRY GANNETT.

With the exception of the redwood forests of California the forests of western Washington are among the densest, heaviest, and most continuous in the United States. Except for a few prairie openings, and except where removed by fire and the ax, they cover the country as a thick mantle from a line high up on the Cascade Range westward to the shores of the Pacific. In all this region only the Olympics rear a few summits above the forests. Not only are the forests dense overhead, but the undergrowth is dense and tangled beneath. The trees are high, reaching 12 to 15 feet in diameter and 250 feet in height, with clear trunks for 100 or more feet. The timber is mainly red fir (*Pseudotsuga taxifolia*) mingled with spruce, hemlock, and cedar.

SOURCES OF INFORMATION.

Since the publication, in the Twentieth Annual Report, of the land-classification map of the State of Washington and the statistics of its standing timber, examinations have been made, somewhat in detail, of the mountain regions of the State, including the Olympic and Mount Rainier forest reserves. The first of these comprises the Olympic Mountains and the country westward, and the second a considerable part of the Cascade Range. Besides this, an examination has been made during the last season of the region in the Cascade Range lying between the northern limit of the Mount Rainier Forest Reserve and National Park on the south and the southern limit of the Washington Reserve on the north.

These examinations have resulted in increasing greatly the estimated stand of timber in the State above the figures published in the Twentieth Annual Report. The additions consist in part of large tracts of heavy stand of species now in use by lumbermen, including red fir, cedar, spruce, and hemlock, and in part of species which are known to be of value although not at present utilized, such, for instance, as the lovely fir.

These mountain regions are not regarded by the lumbermen of to-day as containing merchantable timber, largely because of the inaccessibility of the forests. The Washington lumberman is skimming the cream. He is taking only the best and heaviest of the timber and that which is most accessible, and, from his point of view, timber within the mountains, being difficult to log, is not regarded as having any present value. That it will come into the market eventually, when the more accessible timber is exhausted, it is of course unnecessary to say, and on this account it should properly be included in a statement of the timber assets of the State. The inclusion of these bodies of timber raises the total stand of the State from 114,778,000 M feet B. M. to 195,687,966 M feet B. M.

Besides the information derived from the examinations above noted, the sources of information concerning the lands and forests of Washington are as follows:

The Northern Pacific Railway Company, which has made most elaborate cruisings of that part of its land grant situated west of the Cascade Range, has, with great liberality, through its general manager, Mr. Thomas Cooper, furnished an abstract of all the information in its possession regarding timber lands, including not only the statistics of standing timber, but maps showing the areas at present forested, those naturally unforested, those which have been cut over, and those which have been burned. These statistics have been compiled and the maps have been prepared by Messrs. John M. Rankine and George H. Plummer, of the Northern Pacific Railway office. The commissioner of the State land office has furnished abstracts of all cruisings made for the selection of lands for the State. Besides the above, several lumber companies and owners of timber land have placed their information at the disposal of this office.

The collection of data and preparation of estimates for the counties east of the crest of the Cascade Range has been done by Mr. Fred G. Plummer, who devoted the winter months of 1898–99 to this work.

Altogether, cruisings of more than 2,000,000 acres have been collected. These are scattered widely over the State and represent the stand of timber under all the different conditions of rainfall, temperature, soil, slope exposure, relief, and altitude.

The other factor necessary for obtaining the total stand of timber, the area of merchantable timber, has been obtained from the same sources in the greatest detail, and with this the areas which have been logged and which have been burned in recent years.

In connection with data regarding the stand of timber, its distribution as to species has been obtained, the classification being that recognized by lumbermen.

STAND OF TIMBER.

From these data the total amount of timber in the State, under the Washington lumbering practice, is estimated at 195,688 million feet B. M. Of this amount nearly nine-tenths, or 175,120 million feet, are west of the crest of the Cascade Range. The remainder, 20,568 million feet, is upon its eastern slope and in the northern and eastern portions of the State.

The State of Washington is naturally divided into two parts, which differ from each other widely in respect to timber growth. The line of division is the crest of the Cascade Range, running from the north to the south line of the State. West of it the country is heavily forested, or was before lumbering operations commenced. In this part of the State the areas naturally devoid of timber are few and small and altogether trifling in proportion to the total area. East of it the land is mainly without timber, and where timber exists it is sparse and its quality is inferior.

Moreover, there is a great difference in the species. West of the Cascade Range the prevailing species, which forms nearly one-half of the entire forest, is red fir. This and cedar, hemlock, spruce, and lovely fir (*Abies amabilis*) compose the forest. Fir is found in almost all parts of this region, and throughout the Sound Valley little of any other species is found, the forests being almost pure fir. East of the Cascade Range the forest consists mainly of pine, principally yellow pine, though in the northeast corner of the State a little white pine is intermingled. Red fir is found scattered through the pine forests in considerable proportion, and in the northeastern part of the State larch is abundant. Small proportions of hemlock and cedar are also found, and a trifling amount of spruce and oak.

The following table gives the stand of timber of the species recognized by the lumbermen, in thousands of feet B. M., with the percentage which each bears to the total amount:

Amount and percentage of species of timber in Washington.

Species.	M feet B. M.	Per cent.
Red fir	90,592,926	46
Spruce	8,220,723	4
Cedar	22,646,071	12
Hemlock	41,571,330	21
Lovely fir	8,787,500	5
Larch	4,776,034	2
Yellow pine	13,082,280	7
White fir	1,231,299	1
Other species	4,779,803	2
Total	195,687,966	.....

Dividing the State into the two parts above given, the following tables show the stand of timber in each, with the amount and percentage of the prevailing species:

Standing timber in Washington.

COUNTIES WEST OF CASCADE RANGE.

	M feet B. M.
Total stand	175,120,112
Fir	86,881,834
Per cent of fir	49

COUNTIES EAST OF CASCADE RANGE.

	M feet B. M.
Total stand	20,567,854
Yellow pine	12,851,435
Per cent of yellow pine	61

The following table gives the amount of merchantable timber in each county, classified by species, in thousands of feet B. M., as at present estimated by lumbermen. If it were cut under the practice which prevails at present, these figures represent a close approximation to the amount which would be realized. There is no question, however, that, as in the case of the eastern white pine, a much larger amount will ultimately be realized, for several reasons:

First, the standard will certainly be lowered, so that instead of utilizing only one-third of the tree two-thirds may be used, and many small trees now destroyed by fire in the culled areas will be cut; second, species not now used may come into the market; third, areas now considered inaccessible will serve as sources of supply; fourth, the new growth on cut and burned areas will reach merchantable size long before the old growth is exhausted.

Summary of standing timber in Washington, by counties.

County.	Total stand.	Average stand per acre.	Red fir.	Spruce.	Cedar.
	M feet B. M.	*Feet B. M.*	*M feet B. M.*	*M feet B. M.*	*M feet B. M.*
Adams					
Asotin	79,400	1,200	15,880		
Chehalis	27,632,828	25,000	10,957,668	3,165,557	4,759,920
Chelan	3,095,430	1,810	377,443		47,070
Clallam	25,742,775	29,300	6,482,650	2,393,185	2,537,620
Clarke	711,552	9,300	697,092		14,460
Columbia	182,500	1,700	36,500	9,125	
Cowlitz	7,492,647	17,800	5,683,311	1,089	786,691
Douglas	31,000	1,000	7,750		
Ferry	1,666,500	1,200	333,300		
Franklin					
Garfield	149,700	2,000	29,940	7,485	
Island	430,000		250,000		180,000
Jefferson	20,691,355	26,700	3,033,175	843,250	2,712,790

Summary of standing timber in Washington, by counties—Continued.

County.	Total stand.	Average stand per acre.	Red fir.	Spruce.	Cedar.
	M feet B. M.	*Feet B. M.*	*M feet B. M.*	*M feet B. M.*	*M feet B. M.*
King	11,857,431	14,300	6,306,494	348,103	1,555,209
Kitsap	1,140,900	9,000	1,140,900	.....	.....
Kittitas	3,171,312	5,260	546,556	.....	131,000
Klickitat	743,000	1,400	336,300	.....	.....
Lewis	11,378,162	12,800	8,848,113	.....	1,137,426
Lincoln	12,000	300	1,800	.....	.....
Mason	7,029,429	15,000	4,953,121	8,492	437,778
Okanogan	3,831,260	1,340	533,100	.....	.....
Pacific	7,813,067	16,300	5,498,224	814,953	713,238
Pierce	10,868,440	15,700	6,798,950	200,871	1,286,573
San Juan	.....	.....	.....	.....	.....
Skagit	11,098,111	11,000	6,297,350	184,096	2,716,326
Skamania	11,870,815	15,300	6,117,212	.....	455,115
Snohomish	10,892,195	13,500	7,356,337	42,955	2,050,630
Spokane	716,000	2,100	32,680	.....	29,560
Stevens	2,701,680	1,100	297,185	.....	27,017
Thurston	2,787,343	10,100	2,608,125	462	108,949
Wahkiakum	2,974,107	27,000	1,947,150	182,520	301,757
Wallawalla	5,500	260	1,625	.....	.....
Whatcom	2,708,955	3,000	1,905,962	18,580	596,342
Whitman	35,000	3,000	.....	.....	.....
Yakima	4,147,572	3,620	1,261,033	.....	60,600
Total	195,687,966	9,355	90,592,926	8,220,723	22,646,071

County.	Hemlock.	Lovely fir.	Larch.	Yellow pine.	White fir.	Other species.
	M feet B. M.	*M feet B. M.*	*M feet B. M.*	*M feet B. M.*	*M feet B. M.*	*M feet B. M.*
Adams	.....	.....	.....	.....	.....	.....
Asotin	.....	.....	7,940	47,640	7,940	.....
Chehalis	6,649,683	.....	2,100,000	.....	.....	.....
Chelan	.....	.....	78,450	2,440,067	31,380	121,020
Clallam	11,179,820	3,149,500	.....	.....	.....	.....
Clarke	.....	.....	.....	.....	.....	.....
Columbia	.....	.....	18,250	109,500	9,125	.....
Cowlitz	953,430	.....	68,126	.....	.....	.....
Douglas	.....	.....	.....	23,250	.....	.....
Ferry	.....	.....	333,300	999,900	.....	.....
Franklin	.....	.....	.....	.....	.....	.....
Garfield	.....	.....	14,970	89,820	7,485	.....
Island	.....	.....	.....	.....	.....	.....
Jefferson	8,920,140	5,182,000	.....	.....	.....	.....
King	2,712,971	.....	.....	.....	75,233	859,421

Summary of standing timber in Washington, by counties—Continued.

County.	Hemlock.	Lovely fir.	Larch.	Yellow pine.	White fir.	Other species.
	M feet B. M.	*Feet B. M.*	*M feet B. M.*	*M feet B. M.*	*M feet B. M.*	*M feet B. M.*
Kitsap						
Kittitas	265,911		150,645	1,349,200	520,000	208,000
Klickitat	71,400		10,500	321,100		3,700
Lewis	929,755		1,406		158,941	302,521
Lincoln				10,200		
Mason	1,174,038	456,000				
Okanogan			533,100	2,765,060		
Pacific	786,652					
Pierce	2,099,780				61,585	420,701
San Juan						
Skagit	1,900,339					
Skamania	1,948,042		551,990	230,845	295,207	2,272,404
Snohomish	1,055,737				64,423	322,113
Spokane			121,360	532,400		
Stevens			351,218	2,026,260		
Thurston	69,807					
Wahkiakum	542,680					
Wallawalla			1,625	2,250		
Whatcom	188,071					
Whitman				35,000		
Yakima	123,074		433,154	2,099,788		269,923
Total	41,571,330	8,787,500	4,776,034	13,082,280	1,231,299	4,779,803

The stand is heaviest in Clallam County, in the northern part of the Olympic Peninsula. The next heaviest is in Wahkiakum, in the southwest, near Columbia River. In western Washington the average stand is 16,000 feet; in eastern Washington it is but 1,800 feet B. M.

The entire area of Washington is 66,880 square miles. Of this, 34,245 square miles, or 51 per cent of its area, are covered with merchantable timber.

CLASSIFICATION OF LANDS.

The entire area of the nineteen counties of western Washington is 24,552 square miles. Of this area but 16,554 square miles, or two-thirds, are regarded as containing merchantable timber. Besides this, an area of 2,771 square miles has already been logged; a much greater area, 4,069 square miles, of merchantable timber has been burned. In other words, out of an area of 23,394 square miles formerly covered with merchantable timber, 12 per cent has been cut, 17 per cent has been destroyed

by fire, and the remainder is still covered with standing timber. In this area there are only 1,158 square miles which are naturally timberless.

If we assume that the logged area contained, on an average, the same amount of timber per acre as is still standing in other areas, it appears that since lumbering began in this region there have been cut from it 30,000 million feet B. M.

If we make the same assumption regarding the burned area, it appears that there has been destroyed by fire, without the least benefit to the world, the enormous amount of 43,000 million feet B. M. of lumber. Anyone who has passed the late summer and early fall in this State realizes the enormous destruction which takes place annually at this season. There are fires everywhere, and for weeks at a time the smoke from them lies as dense as the fog on the New England coast.

These are impressive facts. In less than a generation nearly one-third of the timber in one of the richest timber regions on this continent has been destroyed, and of that destruction much more than half has been caused by fire. Nearly two years' supply of lumber for the United States has been thus destroyed. Assuming that the timber so destroyed would, if standing now, have a value of $1 per 1,000 feet, it appears that not less than $43,000,000 worth has gone up in smoke—a dead loss to the people of the State.

In eastern Washington, out of an entire area of 42,328 square miles, 17,691 square miles only are now covered with merchantable timber, or only two-fifths of the area. Of the area at one time timbered, 1,458 square miles have been cut over and 557 square miles have been burned. These figures present a strong contrast with similar figures for western Washington, in respect to both cut and burned areas. The reason for it lies in the fact that in this part of the State the cutting is done only for local consumption and never for export, and in these open, sparse forests of yellow pine fires do not run freely or cause much damage.

The following table shows the classification of lands in the eastern and western parts of the State:

Classification of lands in Washington, east and west of Cascade Range.

Class.	West of Cascade Range.		East of Cascade Range.		The State.	
	Square miles.	*Per cent.*	*Square miles.*	*Per cent.*	*Square miles.*	*Per cent.*
Total	24,552	.....	42,328	.....	66,880	.....
Merchantable-timber area	16,554	.67	17,691	42	34,245	51
Timberless area	582	3	22,620	54	23,202	35
Cut area	2,771	11	1,458	3	4,229	6
Burned area	4,069	17	557	1	4,626	7
Rocky and barren	315	1	2	.....	317	1
Mountain meadows	261	1	.....	.....	261	

The following table presents the classification of lands by counties:

Classification of lands in Washington by counties.

County.	Timbered area.	Timberless area.	Cut area.	Burned area.	Rocky area.	Mountain meadows.
	Square miles.	*Square miles.*	*Square miles.*	*Square miles.*	*Square miles.*	*Square miles.*
Adams	.....	1,696	.....	.....	.....	.....
Asotin	105	520	6	.....	.....	.....
Chehalis	1,714	.....	140	60	42	12
Chelan	2,665	282	26	97	.....	.....
Clallam	1,370	7	113	236	33	48
Clarke	119	.....	20	498	9	.....
Columbia	164	530	182	.....	.....	.....
Cowlitz	646	.....	82	385	32	.....
Douglas	49	4,713	6	.....	.....	.....
Ferry	2,270	38	.....	5	.....	.....
Franklin	.....	1,251	.....	.....	.....	.....
Garfield	128	527	70	.....	.....	.....
Island	.....	.....	238	.....	.....	.....
Jefferson	1,211	.....	81	158	128	187
King	1,289	8	361	393	.....	.....
Kitsap	210	.....	175	22	.....	.....
Kittitas	941	1,261	94	118	.....	.....
Klickitat	825	1,197	26	31	.....	.....
Lewis	1,396	45	71	813	11	.....
Lincoln	63	2,036	200	.....	.....	.....
Mason	729	.....	199	31	20	14
Okanogan	4,468	850	.....	.....	.....	.....
Pacific	764	40	56	65	.....	.....
Pierce	1,079	159	200	76	40	.....
San Juan	.....	.....	187	.....	.....	.....
Skagit	1,576	90	196	12	.....	.....
Skamania	1,209	44	31	459	.....	.....
Snohomish	1,252	28	252	119	.....	.....
Spokane	530	654	585	8	.....	.....
Stevens	3,643	120	23	159	.....	.....
Thurston	430	106	161	66	.....	.....
Wahkiakum	173	22	38	40	.....	.....
Wallawalla	33	1,230	14	.....	.....	.....
Whatcom	1,387	33	170	636	.....	.....
Whitman	19	1,977	109	.....	.....	.....
Yakima	1,788	3,738	117	139	2	.....
Total	34,245	23,202	4,229	4,626	317	261

ADAMS COUNTY.

This county lies in the southeastern part of the State. Its surface consists of a broadly undulating plateau of basalt, containing few stream courses, but many coulees.

The county contains no timber whatever, except strips of willow, alder, and aspen along the few streams.

ASOTIN COUNTY.

This is the southeasternmost county of the State. It consists mainly of the undulating, timberless, basalt plain of Snake River, but into its western edge extends the end of a spur from Blue Mountains, which bears some timber.

Classification of lands in Asotin County.

	Square miles.
Total area	631
Merchantable-timber area	105
Timberless area	520
Cut area	6

Estimate of timber in Asotin County.

	M feet B. M.
Pine	47,640
Red fir	15,880
Larch	7,940
White fir	7,940
Total	79,400

Average stand per acre of timbered land in feet B. M., 1,200.

Besides the above there is on the cut area a small amount, estimated at 2,000,000 feet, still standing, which, added to the above estimate, gives a total of 81,400 M feet B. M. for the county.

CHEHALIS COUNTY.

This county borders upon the Pacific Ocean, and on the north extends far up into the Olympic Mountains. The northern portion is high and rugged, and in other portions there are numerous small prairie tracts. Aside from these areas the county was originally heavily forested, mainly with fir in the interior and with spruce and cedar upon the coast. There have been few fires in this county, and the burned area is trifling. Lumbering has, however, been carried on extensively upon the streams flowing into Grays Harbor, and especially upon Chehalis River, nearly one-tenth of the timbered area of the county having been denuded of its forests.

Classification of lands in Chehalis County.

	Square miles.
Total area	1,968
Merchantable-timber area	1,714
Barren and rocky	42
Burned area	60
Mountain meadows	12
Cut area	140

Estimate of timber in Chehalis County.

	M feet B. M.
Red fir	10,957,668
Spruce	3,165,557
Cedar	4,759,920
Hemlock	6,649,683
Lovely fir	2,100,000
Total	27,632,828

Average stand per acre of timbered land in feet B. M., 25,000.

CHELAN COUNTY.

This county has been recently formed from parts of Kittitas and Okanogan counties. It lies upon the slope of the Cascade Range, extending eastward to Columbia River. Much the larger part of its area is mountainous, and is sparsely timbered, mainly with yellow pine.

Classification of lands in Chelan County.

	Square miles.
Total area	3,070
Merchantable-timber area	2,665
Timberless area	282
Burned area	97
Cut area	26

Estimate of timber in Chelan County.

	M feet B. M.
Yellow pine	2,440,067
Red fir	377,443
Tamarack	78,450
Cedar	47,070
Lodgepole pine	18,497
White fir	31,380
Other species	102,523
Total	3,095,430

Average stand per acre of timbered land in feet B. M., 1,810.

CLALLAM COUNTY.

This county occupies the northern part of the Olympic Peninsula. The southern portion of the county comprises a part of the Olympic Mountains. The remainder of the area was heavily forested, but the ax has made inroads into the forests along the shores of Puget Sound as far west as Crescent Bay, and fires have extended inland from these cuttings to the mountains, destroying considerable areas of timber. The western part of the county is still an unbroken forest.

The forests of this county are remarkable in the fact that they contain a large proportion of hemlock, the amount of this tree being much greater than that of the red fir.

Classification of lands in Clallam County.

	Square miles.
Total area	1,807
Merchantable-timber area	1,370
Rocky and barren	33
Burned area	236
Mountain meadows	48
Cut area	113
Prairie	7

Estimate of timber in Clallam County.

	M feet B. M.
Red fir	6,482,650
Spruce	2,393,185
Cedar	2,537,620
Hemlock	11,179,820
Lovely fir	3,149,500
Total	25,742,775

Average stand per acre of timbered land in feet B. M., 29,300.

CLARKE COUNTY.

This county lies in the southwestern part of the State, bordering on the south and west on Columbia River. Originally it was entirely covered with heavy forests, with the exception of a few small prairie tracts.

But little timber has been cut in the county, lumbering being principally confined to the line of the Portland, Vancouver and Yakima Railroad, and, on the other hand, the timber in more than two-thirds of the county has been destroyed by fire, the burned areas lying principally in the southern and western parts, leaving large bodies of forest in the eastern part.

The forest consists almost exclusively of fir, there being very little cedar and hemlock, and no spruce whatever.

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Classification of lands in Clarke County.

	Square miles.
Total area	646
Merchantable-timber area	119
Barren and rocky	9
Burned area	498
Cut area	20

Estimate of timber in Clarke County.

	M feet B. M.
Fir	697,092
Cedar	14,460
Total	711,552

Average stand per acre of timbered land in feet B. M., 9,300.

COLUMBIA COUNTY.

This county lies in the southeastern portion of the State. Its southern part is occupied by the Blue Mountains, the crest of which runs across the county. Southward they descend rapidly to the canyon of Grande Ronde River and northward to the Columbia Plains. The greater part of the county consists of these plains, which are timberless, with a broadly undulating surface traversed by few streams. The northwest slope of the Blue Mountains was formerly well timbered with pine and fir, but this has mainly been logged off. The summits of these mountains are sparsely timbered, while the southern slopes are timbered quite heavily for this region. There have been no burns in the county.

Classification of lands in Columbia County.

	Square miles.
Total area	876
Merchantable-timber area	164
Cut area	182
Timberless area	530

Estimate of timber in Columbia County.

	M feet B. M.
Pine	109,500
Red fir	36,500
Larch	18,250
White fir	9,125
Spruce	9,125
Total	182,500

Average stand per acre of timbered land in feet B. M., 1,700.

Scattered over the cut area is standing timber to the amount of 60 million feet, which, added to the above estimate, gives a grand total of 242,500 M feet B. M. for the county.

COWLITZ COUNTY.

This county lies in the southern part of the State, being limited on the south by Lewis and Columbia rivers. The eastern portion of the county comprises the western slopes of Mount St. Helens, and includes a considerable area of rugged mountainous country. Aside from this and a few areas of prairie, the county was originally covered with fine merchantable forests. Fires have, however, been extremely disastrous in this county, destroying the timber on large areas, particularly in the eastern and southern parts. Lumbering has been carried on along Columbia and Cowlitz rivers, and considerable areas have thus been denuded; but this bears little comparison to the areas denuded by fire, which comprise fully one-third of the portion originally covered by merchantable forests.

Classification of lands in Cowlitz County.

	Square miles.
Total area	1,145
Merchantable-timber area	646
Barren and rocky	32
Burned area	385
Cut area	82

Estimate of timber in Cowlitz County.

	M feet B. M.
Fir	5,683,311
Spruce	1,089
Cedar	786,691
Hemlock	953,430
Larch	68,126
Total	7,492,647

Average stand per acre of timbered land in feet B. M., 17,800

DOUGLAS COUNTY.

This county lies a little east of the center of the State, its area being comprised entirely within the great plains of the Columbia. It is bordered on the north and west by Columbia River, flowing in a deep and narrow valley. The surface of the county is broadly undulating, consisting of a basalt plateau, intersected by coulees and stream canyons. It is almost entirely treeless, only about 1 per cent of its area being timbered, the timbered areas lying in narrow strips on the edge of the plateau near Columbia River. Along Columbia River, between Wenache and Virginia, are a few scattered pines and firs.

Classification of lands in Douglas County.

	Square miles.
Total area	4,768
Merchantable-timber area	49
Cut area	6
Timberless area	4,713

Estimate of timber in Douglas County.

	M feet B. M.
Yellow pine	23,250
Fir	7,750
Total	31,000

Average stand per acre of timbered land in feet B. M., 1,000.

FERRY COUNTY.

This is a new county, formed in 1899 from the western part of Stevens County, in the northeastern part of the State. Its surface is almost entirely mountainous and broken, and is throughout covered with timber, although the timber is nowhere dense. But one burn of any magnitude has occurred in the county in recent times, and no appreciable amount of timber has been cut.

Classification of lands in Ferry County.

	Square miles.
Total area	2,313
Merchantable-timber area	2,270
Burned area	5
Timberless area	38

Estimate of timber in Ferry County.

	M feet B. M.
Pine	999,900
Fir	333,300
Larch	333,300
Total	1,666,500

Average stand per acre of timbered land in feet B. M., 1,200.

FRANKLIN COUNTY.

This county, which lies in the southeastern part of the State, in the angle between Snake River and the Columbia, is utterly timberless.

GARFIELD COUNTY.

This county lies in the southeastern part of the State, extending from Snake River southward to the Oregon line. The southern part includes a narrow section of the Blue Mountains. These are forested except on the northern slope, which has been largely cut over. The northern portion of the county is comprised in the undulating plain of Snake River and is timberless.

Classification of lands in Garfield County.

	Square miles.
Total area	725
Merchantable-timber area	128
Cut area	70
Timberless area	527

Estimate of timber in Garfield County.

	M. feet B. M.
Pine	89,820
Red fir	29,940
Larch	14,970
White fir	7,485
Spruce	7,485
Total	149,700

Average stand per acre of timbered land in feet B. M., 2,000.

Scattered over the cut area is standing timber to the amount of about 20 million feet, which, added to the above figures, gives a total for the county of 169,700 M feet B. M.

ISLAND COUNTY.

This comprises a group of islands in the northern part of Puget Sound, including Whidby and Camano islands. These islands originally were entirely covered with fir forests, but have been almost completely denuded by the ax.

Classification of lands in Island County.

	Square miles.
Total area, all logged	238

Estimate of timber in Island County.

	M feet B. M.
Fir	250,000
Cedar	180,000
Total	430,000

The above timber is reported as still standing on culled land.

JEFFERSON COUNTY.

This county lies on the Olympic Peninsula, stretching from Hood Canal on the east to the Pacific Ocean. The central portion of the county, comprising three-fourths of it, lies within the Olympic Mountains and contains much rugged country on which the stand of timber is light. Elsewhere the county was formerly heavily forested—on the east with fir, on the west mainly with cedar and spruce. The timber of the eastern portion has been largely destroyed, either by the ax or by fire, mainly by the latter. The timber in the western portion of the county has as yet suffered little from either cause.

The forests of this county are remarkable because of the large proportion of hemlock and lovely fir, more than half the forest being of these species, while of fir, elsewhere the most abundant species, there is comparatively little.

Classification of lands in Jefferson County.

	Square miles.
Total area	1,765
Merchantable-timber area	1,211
Rocky and barren	128
Burned area	158
Mountain meadows	187
Cut area	81

Estimate of timber in Jefferson County.

	M feet B. M.
Red fir	3,033,175
Spruce	843,250
Cedar	2,712,790
Hemlock	8,920,140
Lovely fir	5,182,000
Total	20,691,355

Average stand per acre of timbered land in feet B. M., 26,700.

KING COUNTY.

This county is in the middle of the State north and south, and extends from the crest of the Cascade Range westward to the shores of Puget Sound. Much of the eastern part of the county lies high up in the Cascade Range, where the stand of timber is light. Aside from this and a few trifling areas of prairie, the county was originally heavily forested, but the forests have been largely removed by fire and the ax. The latter has taken the timber from Vashon and Maury islands, from the shores of Puget Sound and of Lakes Washington and Sammamish, and from a broad belt along the line of the Northern Pacific Railway, together with other smaller areas in the interior of the county. Fires have done a vast amount of damage in various parts of the county, mainly in its central portion, although the mountainous regions have not escaped injury.

Classification of lands in King County.

	Square miles.
Total area	2,051
Merchantable-timber area	1,289
Burned area	393
Bare area	8
Cut area	361

Estimate of timber in King County.

	M feet B. M.
Red fir	6,306,494
Hemlock	2,712,971
Cedar	1,555,209
Engelmann spruce	348,103
Lovely fir	439,821

Estimate of timber in King County—Continued.

	M feet B. M.
White fir	75,233
White pine	130,577
Noble fir	29,366
Other species	259,657
Total	11,857,431

Average stand per acre of timbered land in feet B. M., 14,300.

KITSAP COUNTY.

This county occupies the northern part of the peninsula separating Hood Canal from Puget Sound. It was originally entirely covered with heavy fir forests. These have been removed almost completely by the ax from the shores and the islands bordering them. Only a trifling area in the southern portion of the county has been burned, while nearly half the area has been logged. The standing timber consists entirely of fir.

Classification of lands in Kitsap County.

	Square miles.
Total area	407
Merchantable-timber area	210
Cut area	175
Burned area	22

Estimate of timber in Kitsap County.

	M feet B. M.
Fir	1,140,900

Average stand per acre of timbered land in feet B. M., 9,000.

KITTITAS COUNTY.

This county lies in the middle of the State north and south, and stretches from Columbia River to the crest of the Cascade Range. The southeastern portion of the county is within the plains region, while the western portion comprises high and rugged mountain spurs. The plains portion is without timber, excepting a narrow strip along Yakima River. The mountain portion is timbered, but by no means heavily, with yellow pine, fir, and larch. Some timber has been cut from this area, especially west of Ellensburg, and in patches in the mountains in the neighborhood of the Northern Pacific Railway. The burned areas are trifling in extent.

Classification of lands in Kittitas County.

	Square miles.
Total area	2,414
Merchantable-timber area	941
Burned area	118
Timberless area	1,261
Cut area	94

Estimate of timber in Kittitas County.

	M feet B. M.
Yellow pine	1,349,200
Red fir	546,556
Hemlock	265,911
Tamarack	150,645
White fir	520,000
Cedar	131,000
Lovely fir	78,000
Other species	130,000
Total	3,171,312

Average stand per acre of timbered land in feet B. M., 5,260.

KLICKITAT COUNTY.

This county occupies a long, narrow strip bordering upon Columbia River. Its western end is in the foothills of the Cascade Range, whence it stretches far eastward into the plains. The western portion of the county is timbered, and in certain small areas heavily so. The eastern portion, comprising by far the largest part of the county, is without forests. A few small areas have been cut, and at the western end of the county the great burns of the adjoining county, Skamania, have extended into it. These burns have occurred in recent years and restocking is only just commencing upon them.

Classification of lands in Klickitat County.

	Square miles.
Total area	2,079
Merchantable-timber area	825
Burned area	31
Cut area	26
Timberless area	1,197

Estimate of timber in Klickitat County.

	M feet B. M.
Red fir	336,300
Pine	321,100
Hemlock	71,400
Larch	10,500
Oak	3,700
Total	743,000

Average stand per acre of timbered land in feet B. M., 1,400.

LEWIS COUNTY.

This county is situated in the southwestern part of the State, and extends from the crest of the Cascade Range on the east to the Coast Range on the west, including the valley of Cowlitz River. A considerable portion of its area, therefore, is included

within the Cascade Range, where the stand of timber is light. There are many prairies scattered over its surface, which further reduce the original area of merchantable timber.

The timber upon more than one-third of the area of this county has been burned, the burned areas lying mainly in the eastern half of the county, though they are not by any means confined to this part. The cutting of timber has been carried on mainly in the neighborhood of the Northern Pacific Railway, which traverses the county from north to south.

Classification of lands in Lewis County.

	Square miles.
Total area	2,336
Merchantable-timber area	1,396
Rocky and barren	11
Timberless area	45
Burned area	813
Cut area	71

Estimate of timber in Lewis County.

	M feet B. M.
Red fir	8,848,113
Hemlock	929,755
Cedar	1,118,975
White fir	158,941
Noble fir	143,491
Alaska cedar	18,451
Larch	1,406
Other species	159,030
Total	11,378,162

Average stand per acre of timbered land in feet B. M., 12,800.

LINCOLN COUNTY.

This county lies in the eastern portion of the State, upon the great plains of the Columbia, and is bordered on the north by Columbia and Spokane rivers. Its surface is a broad, undulating, basalt plain, traversed by a few stream courses and numerous coulees. The timber consists mainly of yellow pine, and is found in the northern part of the county, near Columbia and Spokane rivers. Formerly it extended in a continuous belt across the county in the neighborhood of these streams, but most of it has been cut away for cord wood and saw logs. The stand is very light.

Classification of lands in Lincoln County.

	Square miles.
Total area	2,299
Merchantable-timber area	63
Cut area	200
Timberless area	2,036

Estimate of timber in Lincoln County.

	M feet B. M.
Pine	10,200
Fir	1,800
Total	12,000

Average stand per acre of timbered land in feet B. M., 300.

Scattered over the cut area is a little standing timber, amounting to about 2,000,000 feet, which, added to the above estimate, gives a total of 14,000 M feet B. M. for the county.

MASON COUNTY.

This county includes the southeastern part of the Olympic Mountains and much of the country bordering Hood Canal. With the exception of a few small prairie tracts, it was originally heavily timbered. Fires have done little damage, but timber cutting has been extensive. The forests have been removed from the shores of Hood Canal and other inlets from Puget Sound, as well as from much of the interior of the county; indeed, it appears that nearly two-fifths of the area has been logged.

The forest consists almost entirely of fir, the amount of other species being trifling.

Classification of lands in Mason County.

	Square miles.
Total area	993
Merchantable-timber area	729
Barren and rocky	20
Burned area	31
Mountain meadows	14
Cut area	199

Estimate of timber in Mason County.

	M feet B. M.
Red fir	4,953,121
Spruce	8,492
Cedar	437,778
Hemlock	1,174,038
Lovely fir	456,000
Total	7,029,429

Average stand per acre of timbered land in feet B. M., 15,000.

OKANOGAN COUNTY.

This large county lies in the northern part of the State, along the Canadian border, and about midway between the east and west boundaries. A large part of the county is comprised within the limits of the Washington Forest Reserve, where the stand of timber is light. Most of the remaining part of the county is timbered but little. It is, in the main, a mountainous region, containing, however, the broad

valley of Okanogan River, which traverses it from north to south, while along the southern edge flows Columbia River in a narrow valley. No lumbering has been carried on in the county, and the forests have not suffered in recent times by fire.

Classification of lands in Okanogan County.

	Square miles.
Total area	5,318
Timbered area	4,468
Timberless area	850

Estimate of timber in Okanogan County.

	M feet B. M.
Yellow pine	2,765,060
Fir	533,100
Larch	533,100
Total	3,831,260

Average stand per acre of timbered land in feet B. M., 1,340.

PACIFIC COUNTY.

This is the southwesternmost county of the State, bordering upon the Pacific Ocean and Columbia River. In the interior its surface is somewhat broken by the Coast Range, although the relief is nowhere great. It is drained by Willapa and Nasel rivers.

Originally the entire surface, with the exception of a few sandy tracts near the coast, was covered with fine forests, composed almost entirely of fir in the interior and of cedar and spruce near the coast.

Logging has been carried on along the two rivers above mentioned, and to some extent immediately on the coast. Altogether only an area of 42 square miles has been logged.

Fires have not been especially prevalent or destructive in this county, having destroyed the timber upon an area of only 59 square miles.

Classification of lands in Pacific County.

	Square miles.
Total area	925
Merchantable-timber area	764
Cut area	56
Timberless area	40
Burned area	65

Estimate of timber in Pacific County.

	M feet B. M.
Fir	5,498,224
Spruce	814,953
Cedar	713,238
Hemlock	786,652
Total	7,813,067

Average stand per acre of timbered land in feet B. M., 16,300.

PIERCE COUNTY.

This, one of the western counties of the State, extends from the crest of the Cascade Range westward to Puget Sound, and includes several islands in the sound. In the east it includes Mount Rainier, with an altitude exceeding 14,500 feet, from whose summit radiate great areas of snow and ice. A large area in the eastern part of this county, lying high up in the range, is sparsely timbered. A considerable area has been logged, including nearly all of the islands, large tracts around the city of Tacoma, and others along White and Puyallup rivers.

This county has been singularly free from fires, only a trifling area having as yet been burned. There are, however, large tracts covering many scores of square miles south of the city of Tacoma which are naturally timberless.

Classification of lands in Pierce County.

	Square miles.
Total area	1,554
Merchantable-timber area	1,079
Rocky and barren	40
Timberless area	159
Burned area	76
Cut area	200

Estimate of timber in Pierce County.

	M feet B. M.
Red fir	6,798,950
Spruce	200,871
Cedar	1,192,539
Hemlock	2,099,780
White pine	86,878
Noble fir	93,458
White fir	61,565
Alaska cedar	94,034
Other species	240,365
Total	10,868,440

Average stand per acre of timbered land in feet B. M., 15,700.

SAN JUAN COUNTY.

This, one of the northwestern counties of the State, is composed entirely of islands in Puget Sound, the principal of which are San Juan, Orcas, Lopez, Blakely, Shaw, and Waldron.

All these islands were originally covered with a heavy forest, composed of red fir almost exclusively, but, being easily accessible, the entire area has been logged.

SKAGIT COUNTY.

This is in the northwestern portion of the State, and extends from the crest of the Cascade Range to Puget Sound, including a number of islands in the sound. The eastern portion, including much more than half the county, being mountainous, has a light stand of timber. The western portion, comprising perhaps one-third of the county, was formerly entirely forested, with the exception of a considerable tract of prairie about the mouth of Skagit River.

There have been no fires of magnitude within the county, but logging has been extensively carried on. The islands have been cleared entirely, and the lands in the neighborhood of the coast and the immediate valley of Skagit River have been cleared as far up as the mouth of the Sauk.

Classification of lands in Skagit County.

	Square miles.
Total area	1,874
Merchantable-timber area	1,576
Burned area	12
Cut area	196
Timberless area	90

Estimate of timber in Skagit County.

	M feet B. M.
Fir	6,297,350
Cedar	2,716,326
Hemlock	1,900,339
Spruce	184,096
Total	11,098,111

Average stand per acre of timbered land in feet B. M., 11,000.

SKAMANIA COUNTY.

This county is in the southern portion of the State, bordering on Columbia River, and extending thence northward well into the Cascade Range. In the northwestern portion of the county is the extinct volcano of St. Helens, while well into the northeast extend the western spurs of Mount Adams. The northern portion of the county is therefore extremely rugged, mountainous, and elevated, and the spurs from these mountains extend southward nearly to Columbia River.

The northern half of the county has a light stand of merchantable timber, although, with the exception of the summits of the highest mountains, which are above timber line, it is wooded. The southern half was at one time quite heavily timbered, especially toward the west. In recent years, however, fires have destroyed the timber in more than half the area of the county. The fires have invaded the eastern and western portions, leaving between them a narrow belt of forests, together

with a broad strip along Columbia River; indeed, the timber upon more than half the area of the county has been thus destroyed.

But little of the timber of this county has been cut. Logging operations extend along Columbia River across the county, reaching perhaps a mile back from the river and up a few of the streams flowing into it.

The forests of this county consist largely of fir and hemlock. The amount of cedar is trifling, and there is no spruce.

Classification of lands in Skamania County.

	Square miles.
Total area	1,743
Merchantable-timber area	1,209
Burned area	459
Timberless area	44
Cut area	31

Estimate of timber in Skamania County.

	M feet B. M.
Red fir	6,117,212
Cedar	455,115
Hemlock	1,948,042
Noble fir	980,065
Lovely fir	639,605
Tamarack	539,290
White fir	295,207
Yellow pine	230,845
White pine	229,573
Larch	12,700
Other species	423,161
Total	11,870,815

Average stand per acre of timbered land in feet B. M., 15,300.

SNOHOMISH COUNTY.

This county extends from the crest of the Cascade Range to Puget Sound. The eastern part is composed of high and rugged mountains, with a light stand of timber. The western half was originally forested, with the exception of a few tracts of prairie. Logging has, however, been carried on extensively in this county, two-fifths of the area formerly timbered having been stripped by the ax. Burns have not been extensive or destructive.

Classification of lands in Snohomish County.

	Square miles.
Total area	1,651
Merchantable-timber area	1,252
Burned area	119
Timberless area	28
Cut area	252

Estimate of timber in Snohomish County.

	M feet B. M.
Red fir	7,356,337
Cedar	2,050,630
Hemlock	1,055,737
Lovely fir	214,742
White fir	64,423
Engelmann spruce	42,955
Other species	107,371
Total	10,892,195

Average stand per acre of timbered land in feet B. M., 13,500.

SPOKANE COUNTY.

This county is situated along the Idaho boundary, and lies about midway between the north and south boundaries of Washington. The eastern part is somewhat hilly and broken, while the western part consists of a portion of the great basaltic plain of the Columbia, intersected by numerous coulees, but traversed by few flowing streams.

Much of the area of this county was formerly timbered, but the timber has been in great part cut away to supply the needs of Spokane and other towns. Very little of the timber has suffered from fire.

Classification of lands in Spokane County.

	Square miles.
Total area	1,777
Merchantable-timber area	530
Burned area	8
Cut area	585
Timberless area	654

Estimate of timber in Spokane County.

	M feet B. M.
Pine	532,400
Larch	121,360
Fir	32,680
Cedar	29,560
Total	716,000

Average stand per acre of timbered land in feet B. M., 2,100.

In the cut area there is still standing scattered timber estimated altogether at 50 million feet, which, added to the above, gives a total of 766,000 M feet B. M. for the county.

STEVENS COUNTY.

This is the northeastern county of the State. It is bordered on the west by Columbia River, while much of its southern boundary is formed by Spokane River. It is, in the main, a mountainous region, but is intersected by the broad valleys of Clark Fork and other streams. Nearly all of its area is timbered, but nowhere densely. Burned areas are more extensive here than in any other of the eastern counties, and there has been considerable cutting in scattered localities.

The species of timber found in the county consist of pine, in which is included both yellow and Western white pine, which are not distinguished, red fir, larch, and cedar. In the western portion of the county, along Columbia River, the timber consists almost entirely of pine, only 4 per cent being fir and 1 per cent larch. In the neighborhood of Colville River the proportion of pine diminishes to 75 per cent and that of fir and larch increases to 10 per cent each, while the proportion of cedar reaches 5 per cent. In the southeastern part of the county the proportion of pine is still further reduced to 60 per cent, while larch increases to 30 per cent, the remainder being made up of equal proportions of fir and cedar. Along the line of the Great Northern Railroad, in the southern corner of the county, the proportion of larch is still greater, reaching 50 per cent in certain small areas.

Classification of lands in Stevens County.

	Square miles.
Total area	3,945
Merchantable-timber area	3,643
Cut area	23
Burned area	159
Timberless area	120

Estimate of timber in Stevens County.

	M feet B. M.
Pine	2,026,260
Larch	351,218
Fir	297,185
Cedar	27,017
Total	2,701,680

Average stand per acre of timbered land in feet B. M., 1,100.

THURSTON COUNTY.

This county lies in the western part of the State, bordering on the north upon Puget Sound. Its area was, with the exception of numerous prairie tracts, originally covered entirely with fine forests, mainly of fir. At present all the forests in the neighborhood of Puget Sound have been cut away. Fires have not been prevalent, and but little timber has been destroyed by this means.

Classification of lands in Thurston County.

	Square miles.
Total area	763
Merchantable-timber area	430
Burned area	66
Cut area	161
Timberless area	106

Estimate of timber in Thurston County.

	M feet B. M.
Fir	2,608,125
Spruce	462
Cedar	108,949
Hemlock	69,807
Total	2,787,343

Average stand per acre of timbered land in feet B. M., 10,100.

WAHKIAKUM COUNTY.

This county lies in the southwestern part of the State, bordering Columbia River. With the exception of some islands in the Columbia and small tracts about the mouths of certain tributary streams, the entire area was heavily forested. Lumbering has been carried on along the shores of the Columbia and on Gray and Deep rivers. Fires also have been somewhat prevalent in the county, but more than two-thirds of its area is still covered by fine forests.

Classification of lands in Wahkiakum County.

	Square miles.
Total area	273
Merchantable-timber area	173
Burned area	40
Cut area	38
Timberless area	22

Estimate of timber in Wahkiakum County.

	M feet B. M.
Fir	1,947,150
Spruce	182,520
Cedar	301,757
Hemlock	542,680
Total	2,974,107

Average stand per acre of timbered land in feet B. M., 27,000.

WALLAWALLA COUNTY.

This county lies in the southern part of the State, being bordered on the north by Snake River and on the west by Columbia River. Its surface is an undulating plain, sloping northward and westward from Blue Mountains.

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The amount of timber in this county was originally small, and this has been entirely logged off, with the exception of about 4,500,000 feet left standing after logging operations. Of this, about half is pine, one-fourth fir, and one-fourth larch.

Classification of lands in Wallawalla County.

	Square miles.
Total area	1,277
Merchantable-timber area	33
Cut area	14
Timberless area	1,230

Estimate of timber in Wallawalla County.

	M feet B. M.
Pine	2,250
Fir	1,625
Larch	1,625
Total	5,500

Average stand per acre of timbered land in feet B. M., 213.

WHATCOM COUNTY.

This is the most northern county of the State west of the Cascade Range. It extends west from the summit of the range to the shores of Puget Sound. In the eastern half of the county are found Mounts Baker and Shuksan, two great extinct volcanoes, rising high above timber line. This eastern mountainous half of the county has a light stand of timber. The western half was originally very heavily timbered. Its forests were probably as dense as those of any other county in the State, but they have been almost entirely destroyed by fire. Certain areas along the coast, on Nooksak River and on the Bellingham Bay and British Columbia Railroad, have been logged, but the amount of timber thus utilized is small as compared with that destroyed by fire. To illustrate the extent of this devastation, it may be stated that out of a timbered area of 1,387 square miles not less than 636 square miles have been burned; 170 square miles have been logged.

The forest consists almost entirely of fir and cedar, the amounts of hemlock and spruce being trifling.

Classification of lands in Whatcom County.

	Square miles.
Total area	2,226
Merchantable-timber area	1,387
Burned area	636
Cut area	170
Timberless area	33

Estimate of timber in Whatcom County.

	M feet B. M.
Fir	1,905,962
Cedar	596,342
Hemlock	188,071
Spruce	18,580
Total	2,708,955

Average stand per acre of timbered land in feet B. M., 3,000.

WHITMAN COUNTY.

This county is in the eastern part of the State, bordering upon Idaho. Its surface is a broadly undulating plain of basalt sloping to the eastward.

It formerly contained a few small areas of timber land in the eastern and northern parts, but these have been logged over, leaving, however, a small amount of timber still standing.

Classification of lands in Whitman County.

	Square miles.
Total area	2,105
Merchantable-timber area	19
Cut area	109
Timberless area	1,977

Estimate of timber in Whitman County.

	M feet B. M.
Yellow pine	35,000

Average stand per acre of timbered land in feet B. M., 3,000.

In the cut areas there is still standing a little timber, estimated at 35 million feet, consisting mainly of yellow pine.

YAKIMA COUNTY.

This county lies in the middle-southern portion of the State, being bordered upon the east by the Columbia River, and extending on the west to the crest of the Cascade Range. The western portion of the county is included within the Mount Rainier Forest Reserve. The estimates of area and of stand of timber do not include the reserve portion.

The eastern portion of the county consists of a broadly undulating plain, and is without forests. The western portion lies in the Cascade Range, is mountainous and broken, and is timbered throughout, but for the most part not heavily. There has been considerable cutting in the lower edges of the mountain forests, particularly upon Naches River, where a large area has been logged. There are no burns except in the southwest corner of the county.

Classification of lands in Yakima County.

	Square miles.
Total area	5,784
Merchantable-timber area	1,788
Rocky and barren	2
Burned area	139
Timberless area	3,738
Cut area	117

Estimate of timber in Yakima County.

	M feet B. M.
Fir	1,261,033
Yellow pine	2,099,788
Tamarack	433,154
White pine	93,406
Mountain fir	2,957
Patton hemlock	1,774
Hemlock	121,300
Lodgepole pine	1,183
Cedar	60,600
Other species	172,377
Total	4,247,572

Average stand per acre of timbered land in feet B. M., 3,620.

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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

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FOREST CONDITIONS

IN THE

CASCADE RANGE, WASHINGTON

BETWEEN THE WASHINGTON AND MOUNT RAINIER FOREST RESERVES

BY

FRED G. PLUMMER

WASHINGTON
GOVERNMENT PRINTING OFFICE
1902

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., June 17, 1902.

SIR: I transmit herewith, for publication in the series of Professional Papers, a report on forest conditions in that part of the Cascade Range lying between the Mount Rainier and Washington forest reserves, prepared by Mr. Fred G. Plummer.

Very respectfully, yours,

HENRY GANNETT,
Geographer.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

FOREST CONDITIONS IN CASCADE RANGE BETWEEN THE WASHINGTON AND MOUNT RAINIER FOREST RESERVES.

By FRED G. PLUMMER.

GENERAL DESCRIPTION.

This report covers that portion of the Cascade Mountains in the State of Washington lying between the Mount Rainier Forest Reserve and the Washington Forest Reserve. It may be more particularly described by Government subdivision surveys as comprising townships 19 to 28 north, and from range 9 east eastward to the Columbia River.

The land-classification map submitted herewith, Pl. I, covers 2,800,000 acres, of which 261,350 acres are naturally timberless areas, such as arid lands, lakes, and glaciers. The remainder, or 2,538,650 acres, is a naturally timbered country, but has lost 204,140 acres, or 8.04 per cent, by fires, and 41,640 acres, or 1.64 per cent, by logging, thus leaving 2,292,870 acres which can at this time be called timber lands. Although these burned and logged areas have to be deducted in estimating the timber, they are nevertheless included in the maps showing the distribution of the various species, for the reason that they lie within the timber zones, and either are or will be restocked with those species that now form the bordering forests.

Of the total area, 179,400 acres, or 6.4 per cent, are estimated as arable; and of this, 13,614 acres, or 7.6 per cent, are under cultivation. The detailed treatment of these areas will be found under the several watersheds and also under the heading "Irrigation."

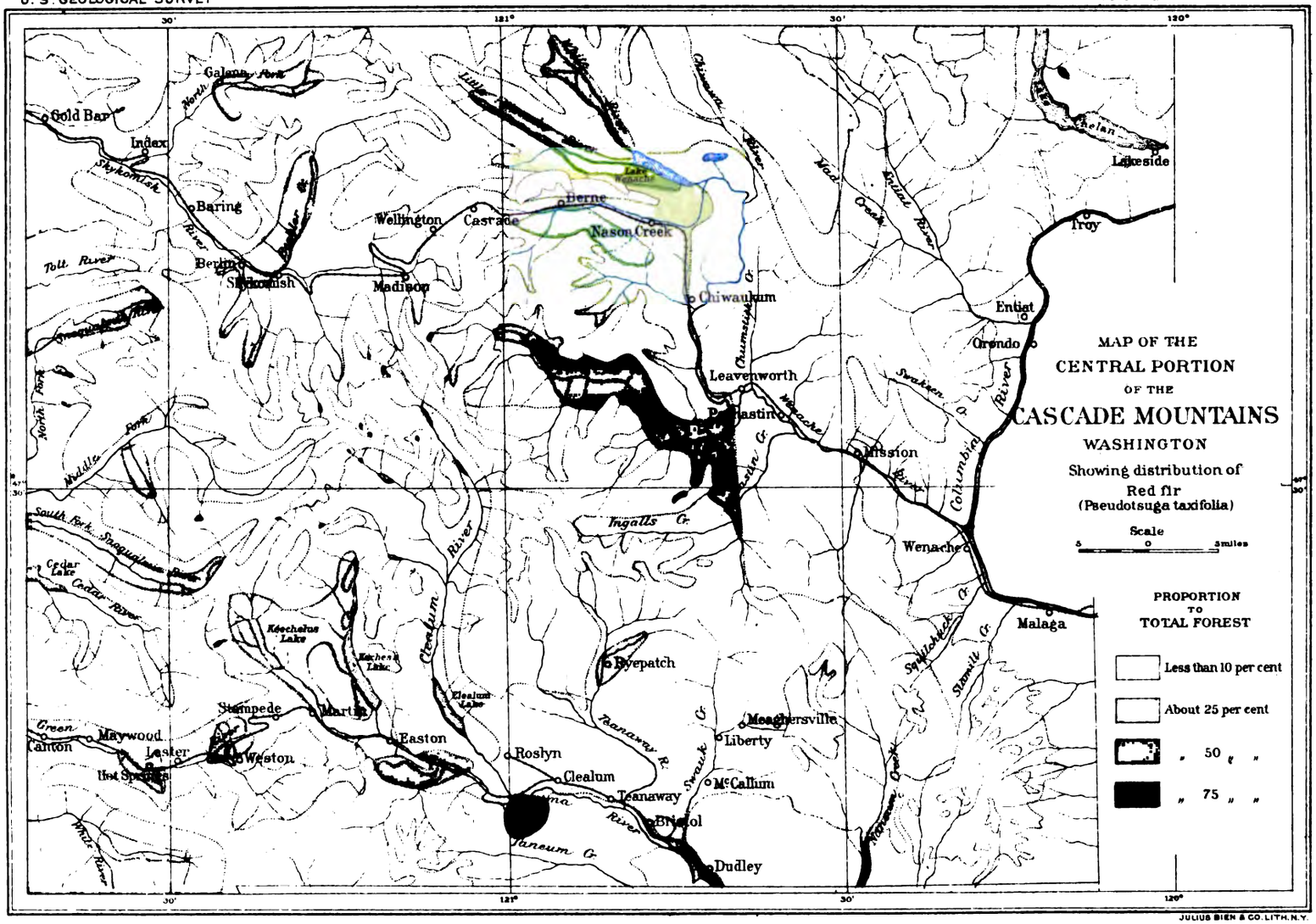
The estimate of the timber now standing upon the 2,292,870 acres of timbered land is 12,001,510 M feet B. M., which gives an average per acre of 5,234 feet B. M. This estimate at first sight appears low, but it results from the fact that 1,520,700 acres, or 66 per cent, of the timbered area are upon the eastern slope of the mountains, which supports a much more open and lighter forest than does the

western slope. The average stand of timber for the western slope is 9,506 feet B. M. per acre, while that for the eastern slope is but 3,064 feet B. M. per acre.

The summit of the Cascade Mountains, as delineated upon the map, is that irregular line which marks the division of the surface drainage westward into Puget Sound and eastward into the Columbia River. This geographical summit is not colinear with the geological summit, nor with the "botanical summit," by which is meant that line which would divide the characteristic western from the eastern growth. Upon the large-scale map this line would be a band or strip varying in width from 4 to 8 miles, and in this strip the timber features of both slopes would overlap, and this overlap strip would extend along the eastern slope, paralleling the geographical summit. In other words, the timber of the western slopes has flowed eastward over the geographical summit—freely through the low passes and with difficulty through the higher saddles or over the ridges and peaks.

The climatology of this region must of necessity be written in a very general manner, as the data are of a fragmentary character and not always trustworthy. The first general truth is that the western slope is a region of excessive humidity, which, with the timber, overlaps slightly onto the eastern slope. The remainder of the eastern slope shows a decrease of precipitation eastward, reaching its minimum in the arid regions of eastern Washington, approximately in R. 30 E. Extremes of temperature prevail east of the mountains, while the western slope has a more equable climate. As a result, the greatest depths of snow are found in the overlap, where the precipitation is great and the winter temperatures are low. The precipitation is heaviest in the Snoqualmie and Cedar River watersheds, and in these it is probably greatest in the Middle Fork Basin, in T. 23 N., R. 11 E. The testimony on this matter from the few who knew the region would warrant the belief that the rainfall exceeds that of any other point in Washington, Clearwater perhaps excepted. Observations at North Bend, in T. 23 N., R. 8 E., show 90 inches annually, and all agree that it rains very much more at Middle Fork. Without vouching for the correctness of this, it is fair to say that my experiences during the last week of the ordinarily dry month of August were exasperatingly confirmatory. In one day, while walking 10 miles along the valley, I crossed more than seventy running streams, of which seven were about 15 feet wide. These streams drained the northern side of that prominent spur of the Cascade Mountains which ends in Preacher Mountain, and none of them could have been over 3 miles in length.

Snoqualmie and Cedar River watersheds, mentioned above, together with the Yakima watershed, on the eastern slope, are deserving of special mention in this report for the reason that the entire minimum flow from their catchment basins will be utilized in the near future for purposes of vital importance. Snoqualmie River now furnishes light and power for the cities of Tacoma and Seattle; Cedar River



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supplies the water to Seattle, and the Yakima irrigates the most important farm lands of the State. Fortunately, large lakes which can be made into impounding reservoirs are well situated in all these watersheds, and their utilization is already receiving serious consideration.

The Northern Pacific and Great Northern railways cross the Cascade Mountains in the area under consideration in this report. For the protection of their roads from forest fires and from falling trees, the rights of way have been cut from 50 to 400 feet in width, according to the condition and size of the timber and the topography. The desire is to remove every tree or snag which threatens the roadbed, sparing nothing which in falling would reach the tracks.

The Cascade Range has been no barrier to the shipment of lumber since the building of these railroads. Large quantities of the fir, spruce, and cedar of the western slopes are shipped for use in eastern Washington, as the better quality of the timber fully compensates for the additional hauling. The yellow pine and tamarack, found only on the eastern slopes, are inferior to the western woods and are never shipped westward except as crates or boxes for fruits or melons.

TREES AND SHRUBS.

List of trees and shrubs found in central Washington.

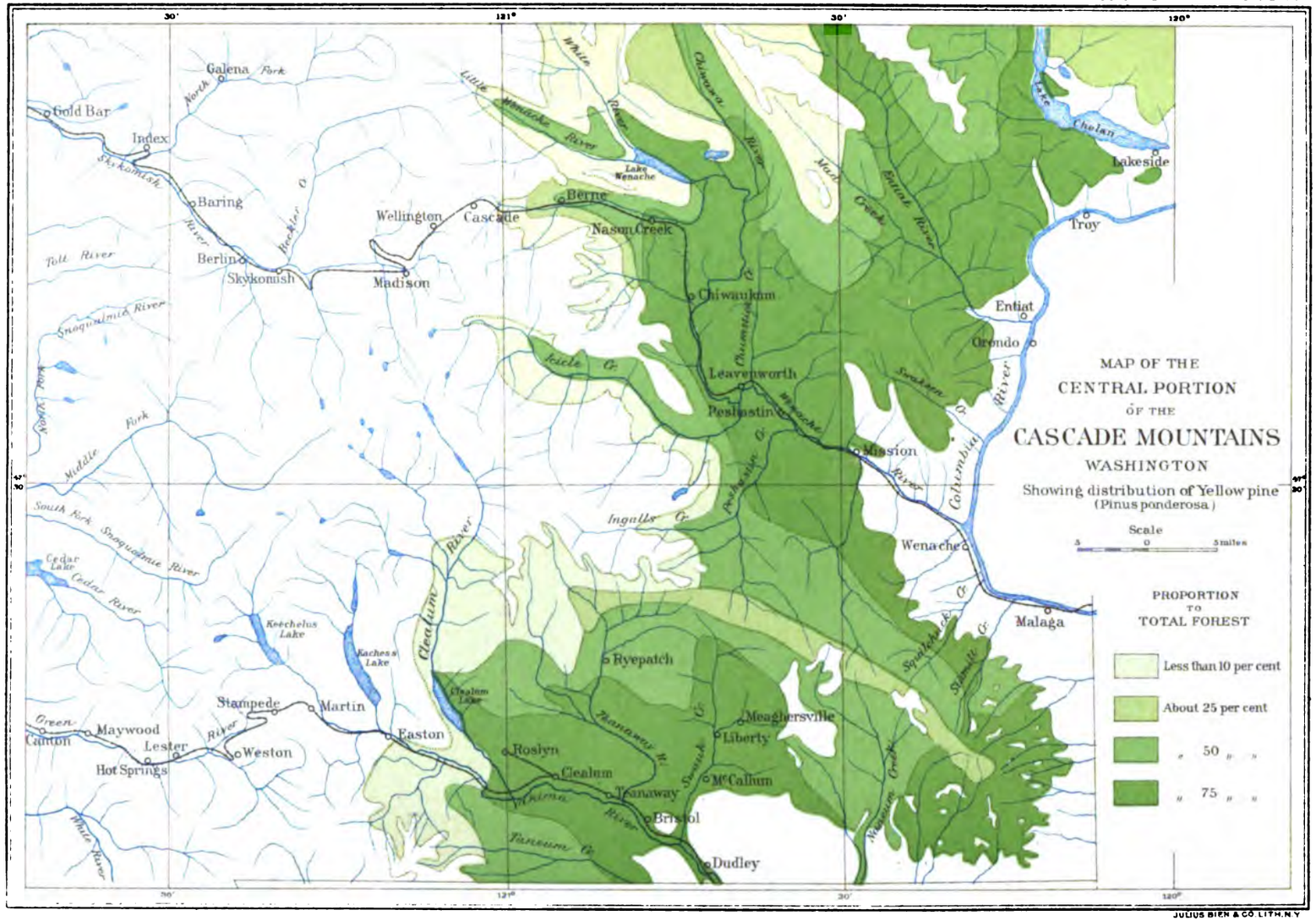
CONIFERS.

White pine	Pinus monticola.
Yellow pine	Pinus ponderosa.
Lodgepole pine	Pinus murrayana.
White-bark pine	Pinus albicaulis.
Noble fir	Abies nobilis.
Lovely fir	Abies amabilis.
White fir	Abies grandis.
Subalpine fir	Abies lasiocarpa.
Mertens hemlock	Tsuga mertensiana.
Patton hemlock	Tsuga pattoniana.
Engelmann spruce	Picea engelmanni.
Red fir	Pseudotsuga taxifolia.
Red cedar	Thuja plicata.
Alaska cedar	Chamæcyparis nootkatensis.
Tamarack	Larix occidentalis.
Alpine larch	Larix lyallii.
Yew	Taxus brevifolia.
Creeping juniper	Juniperus nana.

DECIDUOUS TREES AND SHRUBS.

Cottonwood	Populus trichocarpa.
Quaking aspen	Populus tremuloides.
Maple	Acer macrophyllum.

Vine maple	Acer circinatum.
Dwarf maple	Acer glabrum.
Mountain alder	Alnus viridus.
Red alder	Alnus oregona.
Mountain ash	Sorbus occidentalis.
Longleaf willow	Salix fluviatilis.
Lyall willow	Salix lasiandra lyalli.
	Salix glabra.
Silver willow	Salix sitchensis.
Redberry elder	Sambucus callicarpa.
Blueberry elder	Sambucus glauca.
Sweet myrtle	Ceanothus velutinus.
Thorn apple	Crataegus macracantha.
Dogwood	Cornus nuttallii.
Highbush cranberry	Viburnum pauciflorum.
Bearberry	Rhamnus purshiana.
Syringa	Philadelphis lewisii.
Arrow wood	Spirea discolor.
Buckbrush	Spirea rosea.
Buckbrush	Spirea corymbosa.
Sumach	Rhus glabra.
Birch	Betula sp.
Chokecherry	Prunus demissa.
Wild cherry	Prunus emarginata.
Greasewood	Purshia tridentata.
	Menziesia ferruginea.
Sagebrush	Artemisia tridentata.
Hazel	Corylus rostrata.
Snowberry	Symphoricarpos racemosus.
Oregon grape	Berberis aquafolium.
Oregon grape	Berberis repens.
Devil's club	Echinopanax horridum.
Manzanita	Arctostaphylos uva-ursi.
Kinnikinick	Arctostaphylos nevadensis.
	Lonicera involucrata.
Red currant	Ribes sanguineum.
Mountain salal	Gaultheria ovatifolia.
Red huckleberry	Vaccinium myrtillus microcephyllum.
Black huckleberry	Vaccinium ovatum.
Thimbleberry	Rubus nutkanus.
Salmonberry	Rubus spectabilis.
Blackberry	Rubus ursinus.
Raspberry	Rubus leucodermis.
Prickly gooseberry	Ribes lacustre mollis.
Blackberried gooseberry	Ribes divaricatum.



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DISTRIBUTION OF SPECIES BY ZONES.

The various species of cone-bearers found in the State of Washington have generally been considered in four zones, although it is difficult, indeed, to establish a line of division at any altitude, owing to the fact that the species vary greatly in altitudinal range on opposite slopes of the mountains, and also according to conditions of exposure and moisture. The assignment of the various species to these zones was in conformity with the conditions found in the basins of streams tributary to Columbia River where it cuts the Cascade Range, in latitude 45° 30′. The four zones referred to are as follows:

Forest zones in Washington at latitude 45° 30′.

Yellow-pine zone	Below 3,000 feet
Lodgepole-pine zone	3,000 to 5,000 feet
Subalpine-fir zone	5,000 to 6,000 feet
Whitebark-pine zone	6,000 to 7,400 feet or to timber line

The species are assigned to the zones as follows:

Species comprising forest zones in central Washington at latitude 45° 30′.

YELLOW-PINE ZONE.

Yellow pine	Pinus ponderosa.
Red and yellow fir	Pseudotsuga taxifolia.
White fir	Abies grandis.
Red cedar	Thuja plicata.

LODGEPOLE-PINE ZONE.

Lodgepole pine	Pinus murrayana.
White pine	Pinus monticola.
Engelmann spruce	Picea engelmanni.
Yew	Taxus brevifolia.

SUBALPINE-FIR ZONE.

Subalpine fir	Abies lasiocarpa.
Lovely fir	Abies amabilis.
Noble fir	Abies nobilis.
Mertens hemlock	Tsuga mertensiana.
Alaska cedar	Chamæcyparis nootkatensis.
Tamarack	Larix occidentalis.

WHITE-BARK-PINE ZONE.

White-bark pine	Pinus albicaulis.
Patton hemlock	Tsuga pattoniana.
Alpine larch	Larix lyallii.
Creeping juniper	Juniperus nana.

As might be expected, the assignment thus made will not apply to the area under consideration. The difference in latitude is not great, amounting to only 150 miles, but the climatic conditions are quite different, and compel a new assignment of the species to these zones. It does not appear necessary to change the names of the zones, as the conditions are such as to warrant their use to the northern boundary of the United States, at latitude 49°.

The accompanying diagram, Pl. VII (p. 20), shows the range and development of the trees having any value as timber, including some of the deciduæ; and on comparison with a similar diagram[a] prepared by me for the Mount Rainier Forest Reserve, it shows a general lowering in altitude. The diagram made for the Mount Rainier Forest Reserve, with its average latitude of about 46° 30′, shows an intermediary condition between the assignment just given for latitude 45° 30′ and that which will now be given for latitude 47° 30′.

Species comprising forest zones in central Washington at latitude 47° 30′.

YELLOW-PINE ZONE.

Yellow pine	Pinus ponderosa.
Red fir	Pseudotsuga taxifolia.
White fir	Abies grandis.
Red cedar	Thuja plicata.
Mertens hemlock	Tsuga mertensiana.

LODGEPOLE-PINE ZONE.

Lodgepole pine	Pinus murrayana.
White pine	Pinus monticola.
Engelmann spruce	Picea engelmanni.
Noble fir	Abies nobilis.
Lovely fir	Abies amabilis.
Tamarack	Larix occidentalis.
Alaska cedar	Chamæcyparis nootkatensis.
Yew	Taxus brevifolia.

SUBALPINE-FIR ZONE.

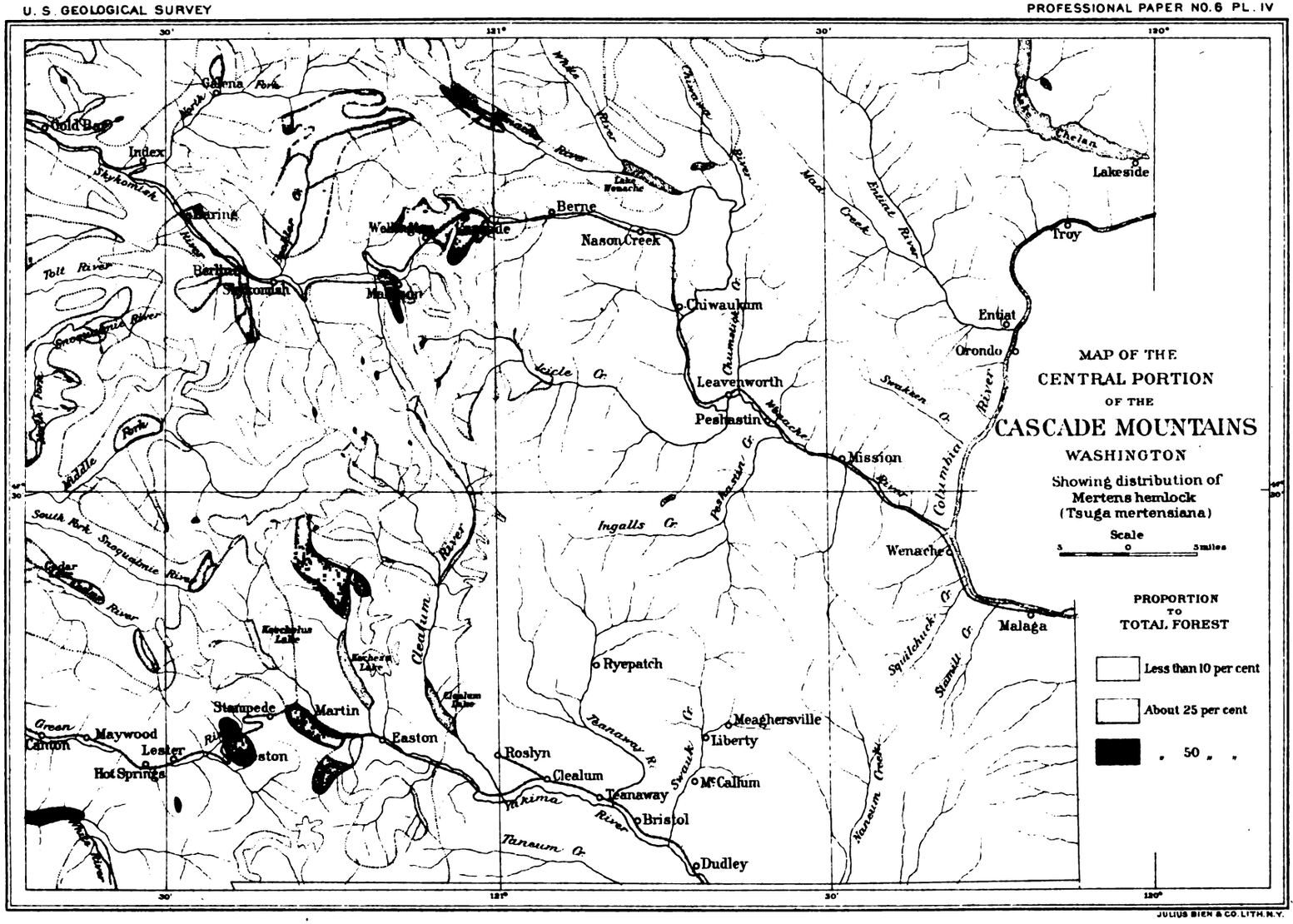
Subalpine fir	Abies lasiocarpa.
Patton hemlock	Tsuga pattoniana.

WHITE-BARK-PINE ZONE.

White-bark pine	Pinus albicaulis.
Alpine larch	Larix lyallii.
Creeping juniper	Juniperus nana.

The range and development of the Alpine larch and creeping juniper are not shown on the diagram, as they did not deserve the extended observations necessary for their determination.

[a] Twenty-first Ann. Rept. U. S. Geol. Survey, Pt. V, Pl. XLI, p. 102.



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EXAMINATION OF A TYPICAL ACRE.

For the purpose of making a detailed record of the amount of vegetable growth supported by the average soil of the Cascade Mountains, an acre was measured near Martin, a station on the Northern Pacific Railway, in an area which had just been estimated as bearing 2,000 to 5,000 feet B. M. per acre. Every tree and sapling, living or dead, was measured and counted. The result was 6,930.8 feet B. M., or 1,930.8 feet more than the maximum of our estimate; but this does not mean that the estimate was erroneous. The fact is that a Michigan mill would cut about 4,000 feet from this acre, and a large western Washington mill would not touch it at all, for their cruisers would note so many piles, ties, telephone poles, or cords of wood, all roughly estimated, and pass on, looking for logs that would square at least 11 inches at the small end. Therefore the following lists of coniferous trees, deciduous trees, and shrubs and flowering plants will be found most interesting and valuable as correctly showing the yield of 1 acre of wildwood.

Number and estimates of the trees found on 1 acre, near Martin.—Elevation 2,700 feet.

Species.	Living.				Dead.				Down.		Total number feet B. M. loggers' scale (Doyle).		
	Over 12 inches diameter.	4 inches to 12 inches diameter.	0 inch to 4 inches diameter.	Real contents, feet B. M.	Over 12 inches diameter.	4 inches to 12 inches diameter.	0 inch to 4 inches diameter.	Real contents, feet B. M.	Fallen.	Cut.	Living.	Dead.	Total.
Red fir (Pseudotsuga taxifolia)	25	7	18	7,231	37	30	...	1,472	2	8	2,892.4	588.8	3,481.2
Mertens hemlock (Tsuga mertensiana)	27	53	60	6,065	9	...	...	1,498	1	...	2,426.0	599.2	3,025.2
White pine (Pinus monticola)	3	7	216	351	...	...	...	.....	1	...	140.4	.....	140.4
Lodgepole pine (Pinus murrayana)	...	...	10	.....	...	...	...	.....	...	...	.....	.....	.....
Lovely fir (Abies amabilis)	1	10	50	384	...	...	...	.....	...	...	145.6	.....	145.6
Noble fir (Abies nobilis)	1	1	....	346	...	...	...	.....	...	...	138.4	.....	138.4
White fir (Abies grandis)	...	...	....	.....	...	...	...	.....	...	1	.....	.....	.....
Red cedar (Thuja plicata)	...	6	45	.....	...	...	...	.....	...	2	.....	.....	.....
Total	57	84	399	14,377	46	30	...	2,970	4	11	5,742.8	1,188.0	6,930.8

There were also found upon this acre the following deciduous trees and shrubs and flowering plants:

Deciduous trees and shrubs and flowering plants found on sample acre near Martin, Wash.

DECIDUOUS TREES AND SHRUBS.

Populus trichocarpa.	Ribes cereum.
Salix glabra.	Vicinium myrtilloides.
Alnus viridus.	Vicinium parviflorum.
Sorbus occidentalis.	Berberis aquafolium.
Acer circinatum.	Pachystina myrsinites.
Amalanchier alnifolia.	Rosa gymnocarpa.

FLOWERING PLANTS.

Xerophyllum tenax.	Lillium columbianum.
Senecio triangularis.	Linnæ borealis.
Chimaphila umbellata.	Epilobium angustifolium.
Clintonia uniflora.	Pedicularis contorta.

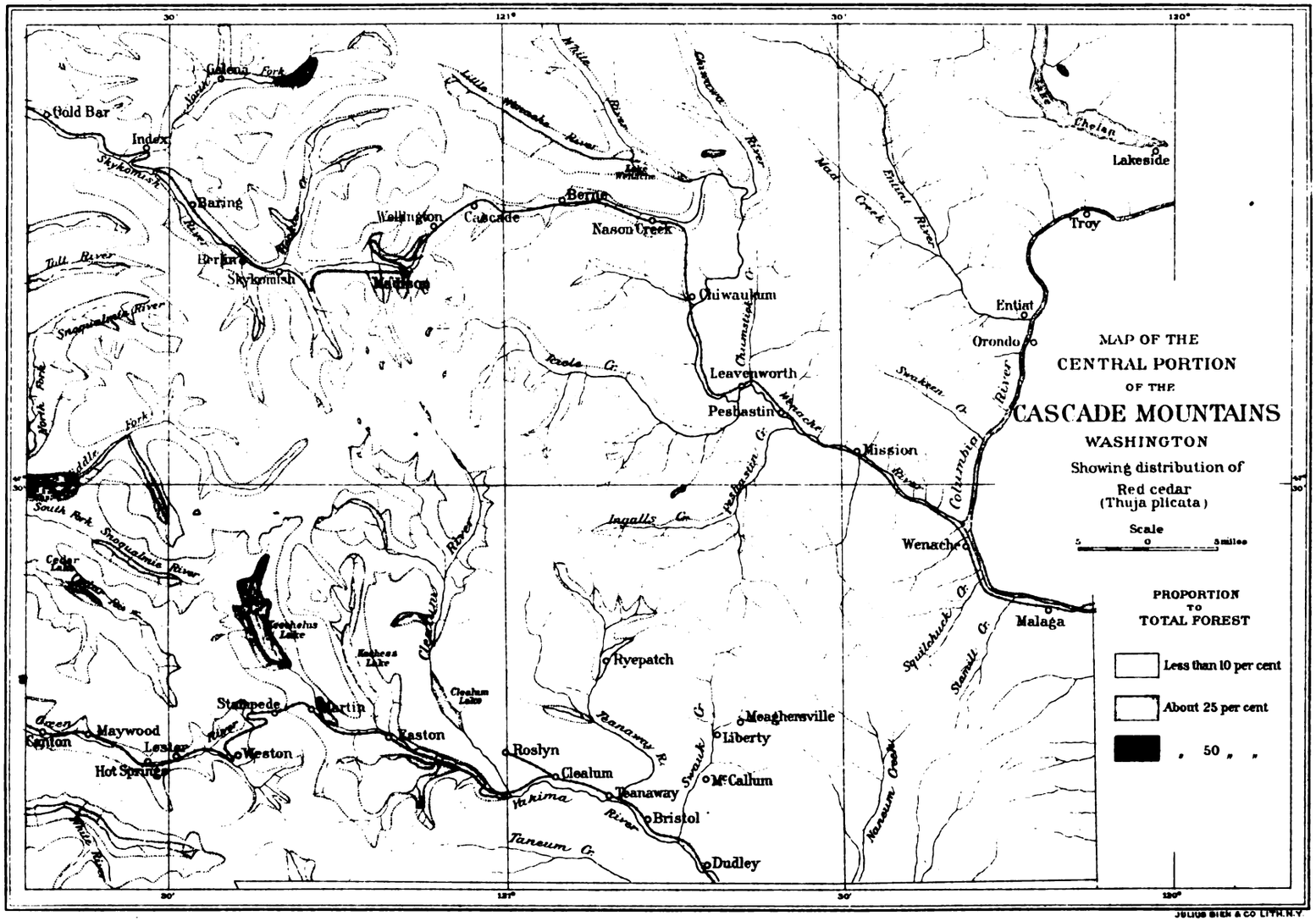
DEFECTS AND DISEASES OF TIMBER TREES.

The forests of this region are, generally speaking, free from serious defects and disease. Those defects which exist are mostly attributable to old age, storms, and fire.

Trees, like every other product of nature, reach an age of maturity. When the life-giving sap no longer ascends to their topmost branches to impart new life and strength, there follows a period, varying in length according to location and exposure, when the tree, like ripened fruit, is at its best. Following this come the elements of disease or decay, and the work of destruction begins either at the center of the base or at the crest, which the sap has failed to reach. Usually it is the former cause, the heart decay beginning before the top has ceased to grow. Year after year the disintegration goes on until the heart wood is entirely destroyed; but the old shell remains standing for many years, protected from the winds by the surrounding trees.

This is the condition that prevails among the red firs (*Pseudotsuga taxifolia*), Mertens hemlock (*Tsuga mertensiana*), white fir (*Abies grandis*), and some other species of the lower zones where no burns have taken place. Numerous old trunks of this kind may be seen which appear like solid shafts, but an examination shows them to be thus defective. An estimate of a tract from which these are eliminated often materially reduces the amount of standing timber from what it appears to be at first glance.

In the canyons and on sheltered slopes the conditions as stated above are common, but in the alpine or subalpine zones the fierce storms usually destroy the



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trees when the trunks become materially weakened. In these zones the greatest defect is what is commonly called "wind shake." The lovely fir (*Abies amabilis*) and Patton hemlock (*Tsuga pattoniana*) are the most frequently injured, showing wide seams from their bases almost to their tops. The white pine (*Pinus monticola*), being soft and flexible, does not suffer materially from this cause. Heart shake is common among the red fir.

Surface fires creep through the forests of yellow pine (*Pinus ponderosa*), burning the humus and litter, frequently running up the trees and igniting the resin which exudes from the trunk or base of the limbs. This results in cavities at the base and a loss to the logger of several feet of the "butt cut." Many complaints are made by lumbermen in the yellow-pine regions of loose black knots, which lower the grade and consequently the market value of a large percentage of the contents of a tree. The cause of this is not obvious, but it is probably due to the annual growth of the tree covering the cambium bark of the limb. When the limb dies by fire or is cast off by natural growth and the knots are covered over by successive layers of wood and bark, the cambium disintegrates from around the body of the incased limb, with the result that the limb becomes loosened from the main body of the tree. Shrinkage of the dead wood may be also a factor in this result.

Very little disease is apparent. Some mistletoe (*Arceuthobium*) was seen in the yellow-pine zone, on the yellow and lodgepole pines, but not in sufficient quantities to injure the trees. Lichen is mostly confined to dead trees in swampy localities.

On steep hillsides avalanches do much damage to timber by stripping off the bark or snapping off the trunks. Great weight of snow often tears the limbs from the trees, and water finding lodgment in the cavities causes decay.

MARKETS AND PRICES OF LUMBER.

Among the timber cruisers and lumbermen west of the summit of the Cascade Mountains the red fir, the red cedar, the spruce, and sometimes the hemlock are known as timber, and if a section of land is called a "timber section" it is understood that it supports a sufficient stand of one or more of these species to make it worth cutting. But logging is by no means confined to the species mentioned, for when a logging road or tramway is once laid into a section it is the practice to remove everything of merchantable value.

As the most extensive of the heaviest stands of timber are in the lower zone, below an altitude of 3,000 feet, and as these lower areas are the most accessible for logging, the species of trees there represented have become best known commercially, but the time is not far distant when the noble fir, lovely fir, hemlock, Alaska cedar, and others, desirable for one purpose or another, will be favorably received

in the market. Modern logging machinery and methods, as applied by skilled labor, have reduced the "inaccessible" areas to a minimum, and it may be truly said that no forest of desirable trees is beyond the possibility of attack.

Aside from a very small local consumption, all the timber of the western slope is tributary to the Puget Sound ports, for either the domestic or the foreign trade, both of which are steadily increasing.

The current market prices (December, 1900) show a slight increase from a year ago, and the few following prices on red fir are given for information:

Prices of lumber in Washington.

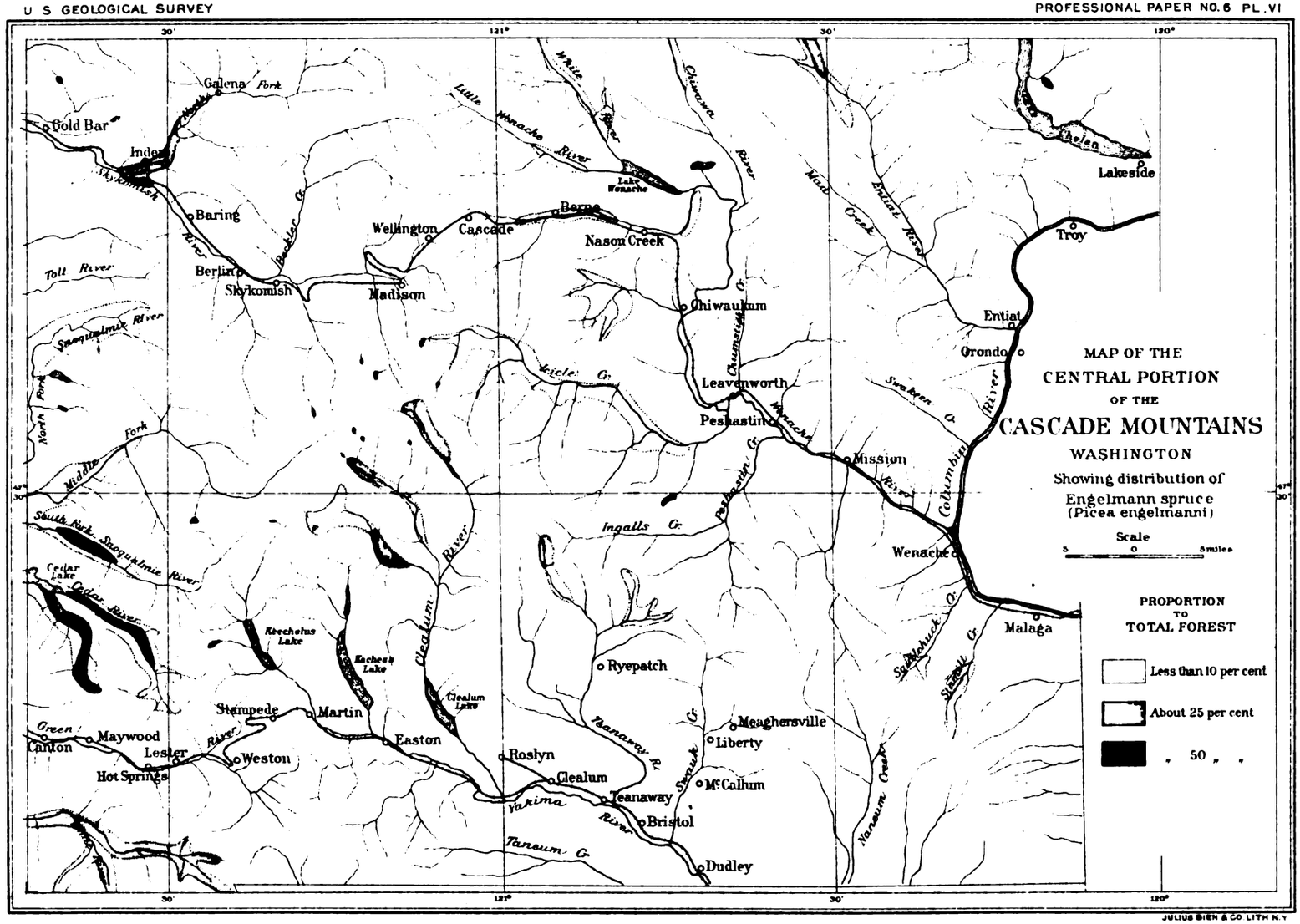
Grade.	Size.	Finish.	Per 1,000 feet B. M. at—	
			Seattle or Tacoma.	North Yakima.
Common	1 by 12 inches	Rough	$7.50	$13.50
Common	1 by 12 inches	Surfaced two sides	10.50	16.50
Flooring V. G. No. 1	1 by 4 inches	Dressed and matched	20.00	25.50
Flooring V. G. No. 2	1 by 4 inches	do	19.00	24.50
Ceiling No. 1	⅝ by 6 inches	Beaded or plain	15.40	19.00
Ceiling No. 2	⅝ by 6 inches	do	14.40	18.00
Wainscoating No. 1	⅝ by 4 inches		12.00	17.00
Wainscoating No. 2	⅝ by 4 inches		10.00	15.00
Shiplap, common	1 by 8 inches		8.50	14.50
Fencing No. 1	1 by 4 inches		8.00	15.00
Fencing No. 2	1 by 4 inches		7.00	14.00
Pickets	1 by 3 or 1½ by 1½ inches			
Lath	⅝ by 1½ inches by 4 feet		[a] 2.00	[a] 3.00

[a] Per 1,000.

The prices on large or long timbers remain the same as given in my report on the Mount Rainier Forest Reserve.

East of the summit of the Cascade Mountains yellow pine (*Pinus ponderosa*) comprises about 85 per cent of the total output of timber for economic uses. Fifteen sawmills are located on the eastern slope, and these are mostly small plants operated during the summer season to supply the local demand. This includes the materials for the construction of irrigation flumes and fences and for the manufacture of fruit boxes and crates to supply the demands of the enormous fruit-growing industries of the Yakima, Wenache, Entiat, and Chelan valleys.

Red fir is cut where obtainable and used for various building purposes, but the wood is inferior to the soft growth of the moist western slope, being harder and much more brittle. According to a section foreman, railroad ties cut from red fir growing at high altitudes or on the eastern slope will last two years longer than



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those cut from Puget Sound timber. Large amounts of red fir and yellow pine are cut for cord wood, and when contiguous to railroads are shipped to interior towns. During construction work on the Northern Pacific and Great Northern railways some yellow pine, lovely fir, tamarack, Engelmann spruce, and red cedar were cut for bridge timbers and ties, but the total amount is insignificant. Some ties of red cedar are used by the Great Northern Railway; and although they resist decay, they do not hold the spikes well and are therefore not as desirable as those made of tamarack or red fir.

The market prices of yellow-pine lumber which prevail throughout this region are as follows:

Prices of yellow-pine lumber in central Washington.

Clear, rough No. 1	per M feet B. M..	$16.00 to $18.00
Clear, rough No. 2	do....	12.00 to 14.00
Clear, rough No. 3	do....	8.00
Cord wood	per cord f. o. b..	2.25 to 2.50

On Squillchuck Creek near Wenache a small plant has been established for the purpose of manufacturing wooden irrigation pipe. This is done by sawing out the center of the sticks, which are from 6 to 12 inches in diameter and 10 feet in length. One end of the pipe thus made is tapered, and the other end is reamed out to form a bell to receive the tapered end of the adjoining pipe. The pipe is laid underground and is claimed to be long lived. Yellow pine is preferred for this purpose, and the core of heartwood taken from the stick is used for fence pickets. If successful, this plant will be of great value to the farmers of that vicinity.

DETAILED DESCRIPTIONS OF AREAS.

SKYKOMISH RIVER WATERSHED.

Prospecting and development work has progressed to a considerable extent and over large areas of this watershed, more particularly on the North Fork and its tributaries and on Miller River and Money Creek. The Great Northern Railway follows the main valley to Stevens Pass, where a tunnel recently constructed passes under the summit, and the valley has thus been opened and its resources made tributary to points both east and west.

Sawmills are in operation at Skykomish, Berlin, Baring, Index, and Gold Bar, all the finished lumber being shipped by rail excepting that for the small local demand at Skykomish and Index. The Skykomish River is drivable, and along its banks considerable cutting has been done, principally of cedar shingle bolts. This culling of individual trees at most accessible locations does not make a logged area, or necessarily precede the clearing of the bottom land for cultivation, but when clearings are made for that purpose the timber is not wasted. Although 15,000 acres of this valley are good agricultural land, only 90 acres are in cultivation.

Areas logged clean are often used for wild pasturage, as the rich soil of these bottoms supports a good growth of grasses and weeds upon which stock do well. In such areas the stumps of trees and the stubble of young growth are generally left to rot until burned or grubbed out to prepare the surface for the plow. The clearing of such land is worth $100 to $150 per acre, and there is little or nothing saved by waiting ten years, or even a lifetime, before removing the stumps. The stump of a newly cut tree burns better than a rotten one, or is lifted and split more thoroughly if powder be used. It means hard work in any case, and the pioneer in such areas earns all that he gets and generally more.

The land-classification map accompanying this report (Pl. I, in pocket) shows the location of the burns. The fact that a line of burned areas closely follows the alignment of the Great Northern Railway strongly suggests that they originated from the construction and operation of the road. Details of dates and circumstances were not obtainable, for railroad men are of a roving disposition and none were met who had been there long enough to give any information. Other burns in this watershed, including those near Cady Pass, have spread from the fires of prospectors and campers.

The principal timber trees are the red fir, red cedar, and hemlock. White fir and Engelmann spruce are also found in considerable quantities in the valley bottoms. Lovely fir has a wide distribution in this watershed and is an important tree in the middle zones. White pine is represented in the mixed forests, but does not make a strong showing in battle with the firs and cedars.

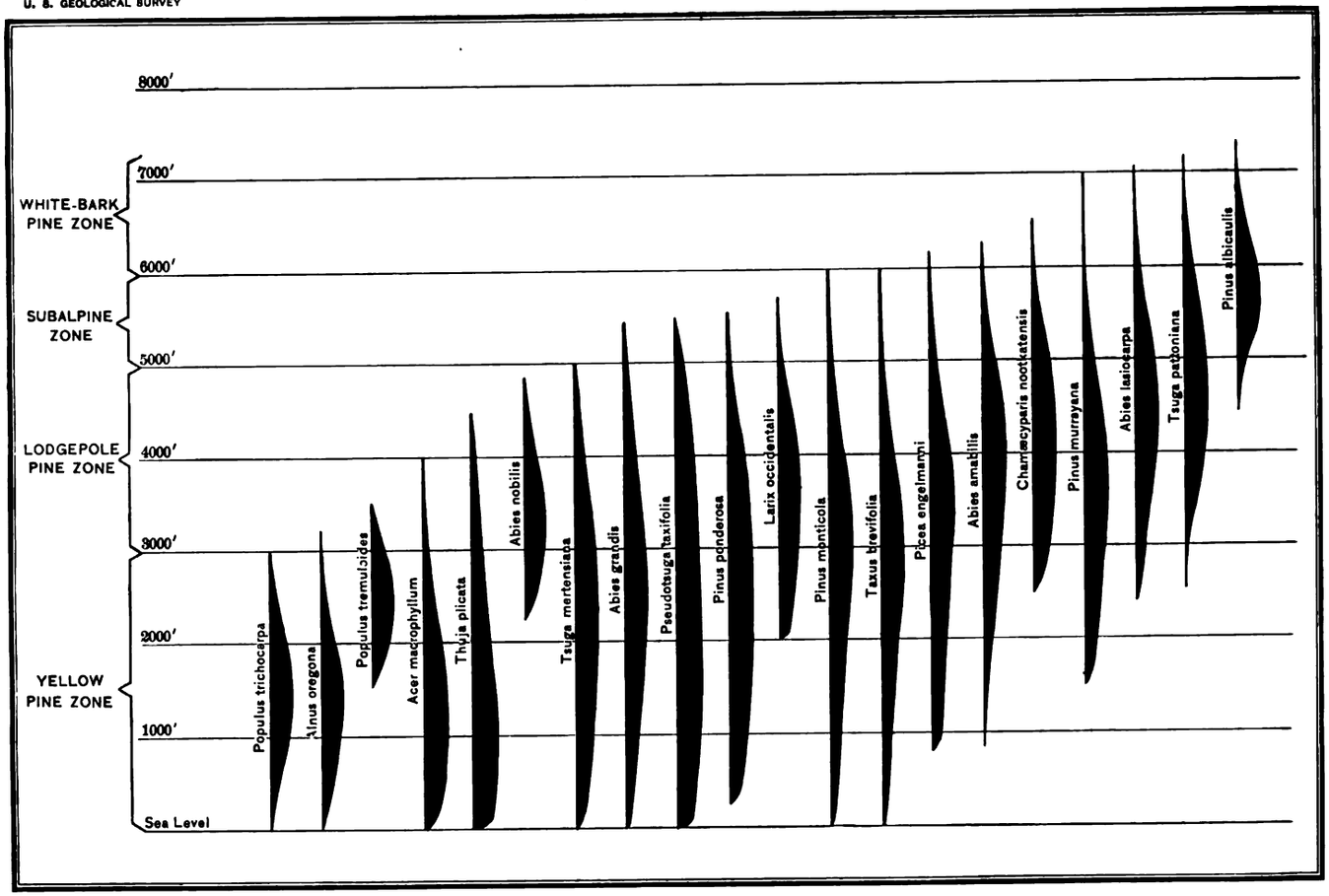
Proportions and amounts of timber species in Skykomish River watershed.

Species.	Per cent.	Estimated B. M.
Red fir	35	1,127,393,750
Mertens hemlock	35	1,127,393,750
Red cedar	10	322,112,500
Lovely fir	10	322,112,500
White fir	3	96,633,750
Engelmann spruce	2	64,422,500
Subalpine fir, Patton hemlock, White-bark pine	5	161,056,250
Total	100	3,221,125,000

TOLT RIVER WATERSHED.

That portion of the Tolt watershed lying in ranges 9 and 10 east is covered by an unbroken forest of hemlock, red fir, red cedar, lovely fir, and some white pine.

This area is not traversed by any of the traveled routes across the Cascade Mountains, and this, together with the fact that it offers little to the prospector and



ALTITUDINAL RANGE AND DEVELOPMENT OF TIMBER TREE SPECIES.

nothing to the stockman, has given it immunity from the destruction likely to follow the advent of man. The stream is not drivable, but the timber will be quite accessible for skid roads and will find an easy outlet westward down the river valley.

Proportions and amounts of timber species in Tolt River watershed.

Species.	Per cent.	Estimated B. M.
Red fir	35	106,333,500
Mertens hemlock	35	106,333,500
Red cedar	10	30,381,000
Lovely fir	10	30,381,000
White pine	5	15,190,500
White fir Subalpine fir Patton hemlock	5	15,190,500
Total	100	303,810,000

SNOQUALMIE RIVER WATERSHED.

Three branches of the Snoqualmie, known as the North Fork, Middle Fork, and South Fork, drain this watershed. The two last mentioned rise in the main range of the Cascade Mountains, being separated from each other by a spur of the main range which ends in Grouse Ridge.

A wagon road follows the South Fork to Snoqualmie Pass, thence into the Yakima watershed, and it is along or near this route that the forests of the Snoqualmie watershed have suffered by fire. The large burn on Denny Mountain was first fired in 1865, and in 1894 a second fire destroyed much of the restocking and included new areas of the forest. The destruction has been almost complete, and there is no immediate danger of a third fire in this area, as there is nothing to burn. Judging from the position of this area, these fires occurred during long and steady north winds, which prevented their spreading over the crest of the hills into Pratt Creek Valley, and at the same time were not severe enough to cross the damp lands of the river bottom to the southward. On Teneriffe Peak the southern slope has been fired several times since 1893, and the area of timber destroyed extends more than 4 miles westward outside of the limits of the area mapped, and includes Mount Si, near the town of North Bend.

The nearest sawmill is near North Bend, 4 miles west of Grouse Ridge. Logging operations on an extensive scale were contemplated in T. 23 N., R. 9 E., but the plans have not yet matured. The streams are drivable for the greater part of the year.

These three forks of the Snoqualmie unite in T. 24 N., R. 8 E., about 3 miles above the falls where the plant of the Snoqualmie Falls Power Company is located. This plant supplies the cities of Tacoma and Seattle with electric power and light,

over wires with a transmission of 30,000 volts. The falls are 270 feet in height, and at the minimum flow of the river give 30,000 horsepower, of which 14,000 horsepower is now developed. As the supply of the river is derived mainly from the melting of ice and snow in the mountains, the importance to the Puget Sound cities of protecting this watershed is apparent.

Considering the entire watershed, red fir and hemlock predominate, forming two-thirds of the timber. In the North Fork Basin there is an unusually heavy stand of hemlock, which, if considered with similar areas in the Skykomish watershed (shown on Pl. IV), shows a broken belt of hemlock extending southwesterly from Chusallie Pass. In the Middle Fork Basin red cedar forms large percentages of the forest, but only over small areas. A peculiar feature of its forests is that the narrow strip of sandy bottom land along the upper valley is timbered with hemlock, while the red cedars and red firs have their best development upon the adjacent hillsides, which are so moist as to support a luxuriant growth of ferns, mosses, and devil's club (*Echinopanax horridum*). The South Fork also has a distinguishing feature in the high percentage of Engelmann spruce, which for a distance of 6 miles along the river benches has developed to an extent equaled only in the Cedar River Valley.

Arable and cultivated lands in Snoqualmie watershed.

Portion of watershed.	Acres arable land.	Acres cultivated land.
North Fork Valley	2,500	18
Middle Fork Valley	5,000	146
South Fork Valley	1,500	113
Total	9,000	277

Proportions and amounts of timber species in Snoqualmie watershed.

Species.	Per cent.	Estimated B. M.
Red fir	35	779,012,500
Mertens hemlock	30	667,725,000
Red cedar	10	222,575,000
Lovely fir	10	222,575,000
Engelmann spruce	7	155,802,500
White pine	3	66,772,500
White fir, Noble fir, Subalpine fir, Patton hemlock, White-bark pine	5	111,287,500
Total	100	2,225,750,000

CEDAR RIVER WATERSHED.

It is from this watershed that the city of Seattle draws its water supply for domestic, manufacturing, and municipal purposes. Its area is only 62,500 acres, but its location in a belt of abnormal precipitation insures an abundant supply at all seasons of the year. It is bounded on the north and east by high peaks, fairly timbered, and in their present condition capable of holding the snows well into the dry season. The slopes south of the river are less abrupt, and, being more protected from the sun's rays and the warm Chinook winds, will assist in giving the slow drainage desired to keep up the flow during the summer months.

The preservation of the heavy forests of the valley lands has been remarkable, for the evidences of small fires started by pleasure seekers, fishermen, and campers are numerous, but in every case the fires have failed to spread. The small burns in this watershed were upon the hillsides and occurred in small timber.

The moist valley lands are the home of the Engelmann spruce, red cedar, white pine, and white fir, which, added to the ever-present and predominating red fir and hemlock, give a mixed forest of unusual interest and beauty. It is entitled to the protection which its commercial importance demands.

The arable lands of Cedar River Valley have an extent of 1,000 acres, of which 24 acres have been in cultivation, but are now abandoned. Not a living man, beast, or bird was seen or heard during the four days spent there. The silence prevailing in this valley was very noticeable as compared with other portions of the Washington forests over which my observations have extended, for there is rarely a day that one may not hear the chatter of the squirrel, the stroke of a woodpecker, or the drum of a pheasant, or see the signs of bear, cougar, or deer. I have learned from others who have visited this valley that their experiences confirm the above.

Proportions and amounts of timber species in Cedar River watershed.

Species.	Percent.	Estimated B. M.
Red fir	40	194,520,000
Mertens hemlock	30	145,890,000
Engelmann spruce	10	48,630,000
Red cedar	5	24,315,000
Lovely fir	5	24,315,000
White pine	3	14,589,000
White fir	2	9,726,000
Noble fir	5	24,315,000
Subalpine fir		
Patton hemlock		
White-bark pine		
Total	100	486,300,000

GREEN RIVER WATERSHED.

The area drained by Green River, comprising [illegible] acres, shows more evidences of extensive burns, both early and recent, than any other watershed examined. Seventeen thousand acres, or about 18 per cent of the total watershed, must be classified as "burned," as the restocking is still in the sapling state, and of no merchantable value.

The first of the destructive fires occurred about thirty-five years ago, as indicated by individual red firs, hemlocks, and Engelmann spruces of that age which survived later fires. In the vicinity of Hot Springs the undergrowth and second growth has been destroyed by fire several times during the last twelve years, and the oldest second growth now showing upon the hillsides is 17 years old. The standing dead snags of the former old growth are of no value. In the bottom or adjacent slopes of the canyon are several small patches of the original forest, in which the growth is thrifty, although the trunks are scorched to a height of 50 feet or more.

During the last ten years three sawmills and two hotels have been destroyed by fire.

A mill in sec. 18, T. 20 N., R. 9 E., cut considerable good timber for local use, and at Lester a mill has cut the timber on about 160 acres for lumber. The remainder of the cutting in this valley has been done by mills since removed or destroyed, and includes an area of 300 acres at Hot Springs, which was cut for local consumption.

About 3,500 acres of bottom land in the Green River Valley may be called arable, but of this at least 80 per cent is of very poor quality. Volcanic rocks predominate in the form of ledges and large bowlders, and render the valley uninviting. The entire cultivated area is only 5 acres, but clover started near Hot Springs has spread over 150 acres of the cut area and made a successful stand against the native weeds.

Proportions and amounts of timber species on Green River watershed.

Species	Per cent.	Estimated B. M.
Red fir	45	168,356,250
Mertens hemlock	30	112,237,500
Red cedar	5	18,706,250
Lovely fir	5	18,706,250
White fir	5	18,706,250
White pine	3	11,223,750
Noble fir	2	7,482,500
Subalpine fir		
Pacific hemlock	5	18,706,250
Alaska cedar		
White-bark pine		
Total	100	374,125,000

WHITE RIVER WATERSHED.

The main forks of White River are supplied by the glaciers and snow fields on the northeast side of Mount Rainier. One of its principal nonglacial tributaries is the Greenwater, which heads in the Cascade Mountains and is within the limits of the examined area.

The old Naches Pass trail, which, prior to the construction of the Northern Pacific Railway, was a well-traveled route from eastern Washington to Puget Sound, follows the Greenwater to the summit. Northward from a favorite camping place at the mouth of the Greenwater is an extensive burn, joining and probably synchronous with the large burn of the Green River Valley, which may thus be traced to campers and packers as well as to the right-of-way clearing of the Northern Pacific Railway. At and near Naches Pass, which is one day's travel from the mouth of Greenwater and a camping place, are several smaller burns in light timber.

The heavy timber of the bottom lands is red fir, red cedar, hemlock, and Engelmann spruce; on the hillsides there is noble fir, lovely fir, white fir, white pine, and Alaska cedar. Four thousand acres of the bottom lands may be classed as arable, as the soil is rich and deep, well watered, and less than 2,000 feet above the sea, but the clearing of this land for the plow will be so expensive as to be prohibitive for some time to come.

Proportions and amounts of timber species in White River watershed.

Species.	Per cent.	Estimated B. M.
Red fir	40	291,780,000
Red cedar	15	109,417,500
Mertens hemlock	15	109,417,500
Engelmann spruce	10	72,945,000
White pine	5	36,472,500
Lovely fir	5	36,472,500
Noble fir	3	21,883,500
White fir	2	14,589,000
Subalpine fir		
Lodgepole pine		
Patton hemlock	5	36,472,500
Alaska cedar		
White-bark pine		
Total	100	729,450,000

[illegible]

The principal streams of [illegible] are the Kachess, Cle Elum, Teanaway, [illegible], Taneum, and the [illegible]. In the accepted nomenclature the main Yakima River heads near Snoqualmie Pass and flows through Keechelus Lake; but the [illegible] is the larger and longer stream.

The Snoqualmie Pass region [illegible] lies in the main Yakima Valley, past Keechelus Lake and over the summit, on a route which has been traveled for forty years. Considering this the [illegible] is a remarkably small proportion of burned area as compared with the region immediately eastward, but the numerous small burns in the vicinity of Keechelus Lake prove that campers and [illegible] were not entirely careful, and observation shows to be a fact that the usual conditions of humidity are not a bar to the spreading of forest fires. The Keechelus Basin, lying east of the summit of the Cascades and paralleling it, is what may be termed the "overlap," and shares the characteristics of the forests of both the eastern and western slopes, supporting both the pen yellow-pine forests of the lower eastern slopes. The forests are very "open," and any of the species represented may predominate over a small area, and the general forest is very mixed as to species. Several of the small burns mentioned occurred in July, 1903, and about the same time fire spread over considerable areas of Goat Mountain, south of the town of Easton. The year 1902 was a [illegible] year for burns, several of which were in the young trees that had not yet passed the burns.

Above Keechelus Lake, more particularly [illegible], there has been considerable prospecting for minerals.

In the Kachess watershed, immediately eastward, the burns are of greater extent, and in the Cle Elum watershed, still farther east and within an area which has been well sheepped and prospected, fires have done great damage in both light and heavy timber. The large burned area shown on the map at the headwaters of the Cle Elum and the Big Salmon Lake rivers is the result of three fires, in 1888, 1895, and 1902. A few scattered areas of the first burn were not refired during the later burns and show a scanty restocking of lodgepole pine, but the remainder of this entire burn presents a scene of desolation not equaled on the eastern slope. In the vicinity of Tuapaw Lake the fires burned so deep into the soil as to absolutely destroy all vegetable matter, leaving only a clean surface of baked soil which will require a lifetime for nature to restock with timber. During the last season some *Juncus*, *Epilobium angustifolium*, and a few other weeds have preempted claims [illegible] some vacant soil, but not a coniferous sapling is to be seen except along the [illegible] of the standing forests where the burns was not utterly destroyed.

From an inspection of the unharmed areas of old growth bordering this burn it was evident that the destroyed forest was of red fir, white pine, Alaska cedar, and

lovely fir. Near the head of the Big Salmon Lasac the Alaska cedar reached a high state of development, comprising at least 40 per cent of the forest. The board measure per acre of Alaska cedar never runs high, but the wood is the most valuable of the Washington woods, and this burn beyond doubt destroyed much of it.

Southward from the area just described the country is scarred by dozens of burns, large and small, with outlines regular or irregular according to the conditions of exposure, the action of the winds, and the nature of the forest destroyed. Details regarding these were not obtainable, only the general statement that hardly a year has passed since 1865 but fire has burned or reburned some area. Some of the restocking would indicate that the date might be set back to 1860. To the southward of Yakima River the tamarack has been the principal reclaimer of large areas, but in the restocked areas north of the main Yakima the conditions are varied, consistent with the very mixed bordering forests, from which a high wind may distribute the fertile seeds of the species when matured.

The Teanaway country, together with the Taneum and all the favorable and accessible areas eastward, has been plentifully sheeped. The forests are generally open, with very little forest litter, and are well watered. The lower country is well and permanently settled by industrious people, who appreciate the value of every little stream which may be diverted to make the naturally rich, but dry, soil productive and who deplore the existence of even the few burns which seem so insignificant when compared with those formerly described. The burns in this watershed as mapped will be a startling exposé of a threatening danger to the most important drainage basin in the State of Washington, so far as water supply for irrigation is concerned.

About 22,000 acres of this watershed have been logged, and of this area 5,258 acres are in cultivation. Mills have been operated at Easton, Big Creek, Roslyn, Clealum, Teanaway, Marysville, and in sec. 14, T. 20 N., R. 16 E. The mill at Marysville has a capacity of only 4,000 feet per day and supplies the local demand for the building of mining flumes and sluices. Along Swauk River the cutting has been mainly for mining timbers, used in the placer diggings, which have been in operation for the last twenty years. Yellow pine predominates in this region, but is not considered as desirable for mining purposes as red fir. The same is true at the coal mines at Roslyn and at Clealum, but at these points the local demand for building lumber is considerable.

Sixty-seven thousand acres are arable, and the location is better indicated on the map submitted herewith than it could be by a description. This estimate refers only to that portion of the Yakima watershed lying within the area examined. The estimates of the available lands lying outside, but which are largely dependent upon the upper watershed for water supply, are given under the heading "Irrigation."

Proportions and amounts of timber species in Yakima River watershed.

Species.	Per cent.	Estimated B. M.
Yellow pine	50	1,305,250,000
Red fir	20	522,100,000
Mertens hemlock	10	261,050,000
Red cedar	5	130,525,000
Tamarack	5	130,525,000
Lovely fir	3	78,315,000
White fir	2	52,210,000
Engelmann spruce	5	130,525,000
White pine		
Noble fir		
Subalpine fir		
Lodgepole pine		
Patton hemlock		
Alaska cedar		
White-bark pine		
Total	100	2,610,500,000

WENACHE RIVER WATERSHED.

The important tributaries of the Wenache River are the Little Wenache, White, Nason, Icicle, Chiwawa, and Peshastin.

The Little Wenache enters Lake Wenache through a wide bottom densely covered with a growth of deciduous underbrush and trees, the latter mainly willow, alder, and maple. In the upper basin is a fine forest of old-growth red fir, red cedar, white pine, and hemlock, besides a smaller growth of lovely fir. Some trees in this old growth have a diameter of 4 to 5 feet and make up a forest, such as is seldom seen in eastern Washington. This body of mixed growth extends along the river about 5 miles. Between it and the white-bark-pine zone the hemlock and lovely fir exclude all other species, except an occasional individual of the species named. At the forks of the Little Wenache a terrific fire has burned along the main stream and a distance of 4 miles up the South Fork, destroying millions of feet of timber, including some of the best cedar in the canyon. Doubtless this fire started from an old trapper's cabin. A smaller and less destructive fire, about 4 miles east of Cady Pass, was traceable to a campfire built on the trail which leads across the summit.

The forests of the Little Wenache are such as would delight the heart of the forest lover, and it is to be regretted that the Washington Forest Reserve does not include this watershed, or that protection of it is not assured from the destruction which is sure to follow the coming of summer campers to this delightful region.

BURN NEAR BERLIN, ON GREAT NORTHERN RAILWAY.

White River also flows into Lake Wenache. Its valley has been a favorite hunting ground for the Indians, as deer, goats, beaver, and smaller game were plentiful, and huckleberries were abundant on the hillsides which had been burned over many years before. About 2,000 acres of this valley is "beaver-dam" land and if cleared might be rated as agricultural, but its high elevation and position in relation to the mountains make this classification doubtful, and this area has not been included in estimating the arable lands of the Wenache watershed. It will, however, add to the value of this region for grazing purposes, as in its wild state it supports a rank growth of forage grasses. The evidences of very old burns are numerous, but restocking is well advanced. The causes of these old burns must be assigned to the Indians.

Nason Creek, before the advent of the Great Northern Railway, bore much good timber, but fires set to clear the right of way during construction work spread over considerable areas of the valley and adjacent hills, and these, together with the cutting for railroad uses, have greatly reduced the amount of standing timber. The best timber of the upper basin was found in the vicinity of the Cascade tunnel, and consisted of lovely fir, Patton hemlock, and Engelmann spruce, with some red cedar. Near Nason Creek station a mill having a daily capacity of 10,000 feet is in operation, and ships lumber to Wenache. Between this point and Merritt are about 300 acres of good hay land, but at an altitude which insures frosts every month of the year. The same is true of 250 acres lying beween the mouth of the creek and the point where the railroad leaves the creek.

The pass through which the railroad runs via Skeeney Creek contains some good pine timber, but much of the best has been culled for saw logs and cord wood. Large quantities of cord wood are shipped to the timberless areas of central Washington.

Icicle Creek, from a point 3 miles above its junction with the Wenache, flows through a narrow canyon with walls rising in places 5,000 feet on either side. Its watershed is an irregular triangle bounded by the main divide of the Cascades on the west, the Mount Stuart divide on the south, and the Chiwaukum Mountains on the northeast. These three snow-capped ranges compel an increased humidity and frequent storms during the summer season, which, together with melting snows, maintain a large and constant waterflow. Owing to the abnormal precipitation and the general inaccessibility of the watershed few burns have occurred and these are of small extent. The arable lands of Icicle Valley are at the mouth of the creek, where the bottom widens to join that of Wenache River, and have an area of about 1,200 acres, of which only one-third is good, the remainder being rocky. Excepting this tract the soil formation of the watershed consists principally of rock in the form of ledges and bowlders, owing to the wide range of altitude; nevertheless, the valley

supports a varied growth of the forest trees. All of the coniferous timber trees were found, excepting the noble fir (*Abies nobilis*), and it is very probable that this species is represented by some individuals, as its northern limit of distribution is at least latitude 48°. Here was found the woolly larch (*Larix lyallii*).

The Chiwawa Valley, below the Washington Forest Reserve, varies in width from a half to three-fourths of a mile. The soil in the upper portion, near the reserve, is scoria sand and decomposed pumice overlying a deposit of gravel and bowlders, hence it is of very poor quality and utterly unfit for cultivation. It is the home of the lodgepole pine, which claims the entire bottom and extends far up on the hillsides of the western slope. The canyon is fairly well timbered, but the trees are mostly small or saplings. Many years ago extensive fires swept over this region, and these areas were reclaimed by the lodgepole pine assisted by the red fir, white fir, and the yellow pine in the more favored localities. Between Fish Lake and the Chiwawa is a dense growth of mixed species, including white pine. Some of this land, if cleared, would be fair agricultural land, but altitude and location are unfavorable, and the natural classification of the watershed is grazing land.

On Peshastin Creek headwaters the forest cover is mainly a young growth of tamarack which many years ago reclaimed a large burned area. Outside of this the yellow pine prevails, with some red fir and white fir and tamarack. The soil is rocky and extremely shallow throughout the canyon, and the only arable land in the watershed is at the mouth of the creek and at a point called Camas Land. Aside from its value as grazing land, which this watershed shares with almost every watershed on the eastern slope of the mountains, its value as mineral land has to some extent been demonstrated, and it follows that the timber, although of small size, already has a value for mining purposes. At Blewitt a 20-stamp mill handles the output of the mines, and a large number of tunnels have been driven into the mountains, all of which require more or less timber. Large numbers of poles have been cut in distant burns along the tops of the hills and slid down the mountains to the works. These are mostly tamarack, averaging 9 inches in diameter at the stump. In a short time this section will be denuded of serviceable timber and the young growth of the canyons will be utilized.

In addition to the descriptions of the main tributaries as above given, there remains to be described the main Wenache Valley. From Leavenworth to Columbia River, a distance of 25 miles, this valley, together with large areas of its adjoining slopes, is arable and well situated for agricultural purposes and for irrigation. Out of a total of 48,000 acres of arable land, 5,565 acres are in cultivation, and the fertility is therefore demonstrated.

Forty years ago the first white settlers came to this valley and engaged in stock raising, trading, and packing. Near the mouth of the river some of the small

A. RED FIR ON GREAT NORTHERN RAILWAY.

B. FOREST ON NORTHERN PACIFIC RAILWAY.

tributaries were diverted to irrigate garden patches, and since that time settlement has increased slowly but steadily. Before the building of the Great Northern Railway this region was approached by a road leading over the Wenache Mountains, or in part by Columbia River, for the Wenache itself is not navigable except for canoes, and then not at low water. Although the railroad has made the markets more accessible, and has stimulated industry to a considerable extent, still the increase in cultivated lands since the railway was built is not over 20 per cent of the total.

Proportions and amounts of timber species in Wenache River watershed.

Species.	Per cent.	Estimated B. M.
Yellow pine	65	1,019,850,000
Red fir	20	313,800,000
Tamarack	5	78,450,000
Red cedar	3	47,070,000
White fir	2	31,380,000
Engelmann spruce		
Mertens hemlock		
White pine		
Lovely fir		
Noble fir	5	78,450,000
Subalpine fir		
Lodgepole pine		
Patton hemlock		
Alaska cedar		
White-bark pine		
Total	100	1,569,000,000

ENTIAT RIVER WATERSHED.

Entiat River flows through a deep canyon varying from a narrow gorge to a half mile in width. This canyon is settled to the northern line of township 27 north, a distance of about 20 miles, but many of the locations are abandoned the greater part of the year. Hay and cattle are the principal products of the upper valley. For a distance of 4 miles upstream from the mouth of the Entiat there is no timber, and in this region hay and fruit are the most important products. Fruit of an excellent quality is produced in abundance, and finds its local market at Wenache via the small steamers which ply Columbia River. From Wenache the distribution is made by the Great Northern Railway to points both east and west.

Irrigation is required for all crops. The soil is mostly light sand and decomposed country rock, and varies in depth from a few inches to 20 feet, with some

A HEAVY STAND OF RED FIR.

B HEMLOCK ON MIDDLE FORK OF SNOQUALMIE RIVER.

Proportions and amounts of timber species in Lake Chelan watershed.

Species.	Per cent.	Estimated B. M.
Yellow pine	85	94,775,000
Red fir	10	11,150,000
Lodgepole pine, Subalpine fir, Patton hemlock, White-bark pine	5	5,575,000
Total	100	111,500,000

SUMMARY.

Stand of timber in central Washington.

Watershed.	Area.	Stand.	Average stand per acre.
	Acres.	*Feet B. M.*	*Feet B. M.*
Skykomish	364,800	3,221,125,000	8,800
Tolt	36,460	303,810,000	8,300
Snoqualmie	190,000	2,225,750,000	11,700
Cedar	56,100	486,300,000	8,700
Green	76,750	374,125,000	4,900
White	48,060	729,450,000	15,200
Yakima	570,000	2,610,500,000	4,600
Wenache	686,200	1,569,000,000	2,300
Entiat	175,500	369,950,000	2,100
Chelan	89,000	111,500,000	1,250
Total	2,292,870	12,001,510,000	5,230

Classification of lands in central Washington.

Watershed.	Total.	Logged.	Burned.	Timberless.	Timbered.	Arable.	Cultivated.	Irrigated.
	Acres.	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*	*Acres.*
Skykomish	389,000	850	21,500	1,850	364,800	15,000	90	.....
Tolt	36,500	.....	40	.....	36,460	.....	.....	.....
Snoqualmie	206,000	200	15,000	800	190,000	9,000	277	.....
Cedar	62,500	.....	5,500	900	56,100	1,000	24	.....
Green	95,500	1,750	17,000	.....	76,750	3,500	5	.....
White	55,500	40	7,400	.....	48,060	4,000	5	.....
Yakima	754,000	22,000	85,000	77,000	570,000	67,000	5,258	1,700
Wenache	853,000	13,300	35,500	118,000	686,200	48,000	5,565	17,000
Entiat	212,000	1,000	15,500	20,000	175,500	4,900	516	1,000
Chelan	136,000	2,500	1,700	42,800	89,000	27,000	1,874	.....
Total	2,800,000	41,640	204,140	261,350	2,292,870	179,400	13,614	19,700

A RED CEDAR, 20 FEET IN DIAMETER.

B. HEMLOCK, MAPLE, AND ALDER.

IRRIGATION.

It is estimated that there are five million acres of arid land in the State of Washington, all of which is in the central portion of the State, east of the Cascade Mountains and in the drainage basin of Columbia River. An estimate of the irrigation possibilities of these five million acres, as determined from data furnished by the Northern Pacific Railway Company, and from other sources, is as follows:

Estimate of irrigation possibilities in central Washington.

	Acres.
Under constructed canals and in cultivation	150,000
Under constructed canals, not in cultivation	100,000
Under canals surveyed but not constructed, and the feasibility of which, at reasonable cost, has been determined	1,080,000
Under canals projected, but feasibility at a reasonable cost is undetermined	510,000
Balance, presumed to be above possibility of irrigation, at cost justified by present conditions	3,160,000
Total	5,000,000

The Cascades and the other mountain ranges which encircle the arid district will afford, if properly conserved, an adequate supply of water for all of the land that can be watered within the limits of reasonable cost. As Columbia River flows through the arid district in a narrow, deep valley having steep slopes, it affords but few opportunities for irrigation. Its main tributaries, with the exception of Snake River, offer more favorable conditions, and in this respect Yakima River is the most important in the State.

Of the total of 250,000 acres now under constructed canals, 203,900 acres are supplied by Yakima River and its tributaries. Of this latter area, the drainage basin of Yakima River as covered by this report is the sole supply for 12,750 acres, and furnishes 68 per cent of the water for the remaining 191,150 acres.

Out of the 1,080,000 acres set forth above that can be irrigated at reasonable cost, 785,000 acres are in the Yakima watershed and will be dependent upon the area treated in this report for about 25 per cent of their water supply.

From careful estimates it appears that there are at present 131,260 acres of arid land dependent for their water supply upon that portion of the Yakima watershed treated in this report, and that this dependent area will eventually be increased to 325,700 acres when the proposed canals are constructed. To irrigate this greater area there will be required about 2,000 cubic feet per second of time, and as the minimum flow of Yakima River is only 800 second-feet, recourse must be had to storage for the additional 1,200 feet. Three lakes, the Keechelus, Kachess, and

Clealum, are well situated for the impounding of a reserve supply, and have areas and capacities as follows:

Areas and capacities of Lakes Keechelus, Kachess, and Clealum.

Lake.	Area.	Height of proposed dam.	Capacity.
	Acres.	*Feet.*	*Acre-feet.*
Keechelus	1,812	30	50,800
Kachess	3,968	30	91,000
Clealum	2,615	30	65,400
Total	8,395	.....	207,200

This storage will furnish 1,200 cubic feet per second for 87 days, no allowance being made for evaporation or contingencies. It is confidently believed that this storage will be a safe insurance against any unusual season of drought.

From all the above it will be evident that the construction of these reservoirs and the preservation of their natural watersheds is imperative. This means that logging should be done under proper restrictions, and that the wanton destruction of the forests by fire must cease.

In the Wenache and Entiat watersheds the conditions are not so urgent. The areas which can be covered by gravity canals are small, and the supply is ample. At present the Wenache covers 17,000 acres of land, and feasible canals projected will increase this to 23,500 acres. The Entiat supplies about 1,000 acres.

GRAZING.

In the area treated in this report grazing is confined to the eastern slope. A few horses, most of which are Indian cayuses, range upon the bunch-grass hills near Columbia River. But few cattle are raised aside from those kept for domestic purposes.

Owing to the extreme roughness of a large portion of this area, cut and broken as it is by steep rocky ridges and precipitous canyon walls, sheep grazing is practicable only in certain limited tracts. As yet it is confined to the Yakima slope south of Clealum, the Teanaway and its tributaries, the high divide extending from Columbia River westward to Mount Stuart, the southern slope of Mount Stuart, and the Entiat and Mad River divides near the Washington Forest Reserve. Sheep are driven into this area from Yakima, Ellensburg, from east of the Columbia River, and even from Oregon.

The sheepmen complain of the range being overstocked. One owner declared that if some new pasture is not discovered the sheep will die in the hills.

Starting in the early spring, as soon as the lambing season is over, they leave the low hills along Columbia River and are driven toward the high mountains, which are reached soon after the winter snows have melted. Here they must remain until the fall rains have caused the grass to grow in the lowlands. Forage plants do not grow profusely in any of these sections. At the lower altitudes, among the pine woods, the pine grass (*Calamagrostis suksdorfi*) is the most important. Sheep do not relish this grass, eating it only when nothing else is to be found. They pass over this very rapidly, and large areas are required to keep them constantly in fresh pasture. One band was seen on the Middle Fork of the Teanaway where the hills were covered with this grass, but it seemed to be almost untouched. The sheep were gathered in the ravines, browsing upon wild cherry, hazel, and vine maple. In the grazing areas there is very little underbrush except in the moist canyons and ravines, which are often inaccessible. At the high altitudes, such as the divides running down from Mount Stuart, various alpine grasses are found which make very desirable feed. Fat formed from this dry feed is much harder than that gained from the soft watery grasses of the swamps.

About the head of Mad River and the Entiat, grazing is mostly done at the altitudes above the yellow-pine zone, where a scrubby growth of subalpine fir, white-bark pine, and lodgepole pine forms a scattered forest which has been greatly reduced by fire. Willow, huckleberry, pea vine, lupine, and various grasses and juncus have covered the hillsides, but the trampling and cutting of thousands of hoofs has in many places denuded the ground of every trace of vegetation.

Upward of 60,000 sheep were said to be ranging in this section and upon the tributaries of Entiat River in the Washington Forest Reserve. About 15,000 were reported on the Teanaway, and a number of bands were in the Mount Stuart region.

MINERAL SPRINGS.

Springs of mineral, sulphur, or soda water are not uncommon in the Cascade Mountains, and there are some deserving of mention.

At Hot Springs, a station on the Northern Pacific Railway, there are five springs which have become well known by reason of their desirable medicinal properties and their accessibility. At this point a large hotel is being built to replace one destroyed by fire in 1899. Three of these springs have temperatures of from 120° to 122° F., and can therefore be used for bathing and heating purposes.

Analyses made in 1893 gave results as follows:

Analyses of water from mineral springs near Hot Springs station, Wash.

Constituent.	No. 1.	No. 2.	No. 3.
	Grains per gal.	*Grains per gal.*	*Grains per gal.*
Sulphate of lime	1.3707	1.3315	0.7358
Sulphate of potash	2.1666	2.4353	1.2439
Sulphate of soda	.....	.....	1.5417
Chloride of potassium	10.4302	12.1715	.....
Chloride of sodium	2.7564	1.2964	9.5762
Chloride of magnesium	0.5840	Trace.	.....
Chloride of iron	0.1810	0.1343	.....
Carbonate of soda	.....	.....	0.8234
Carbonate of magnesia	.....	.....	0.0701
Carbonate of iron	.....	.....	0.0408
Silica	4.5552	5.0808	4.7479
Lithia	Trace.	Trace.	Trace.

On Burnt Boot Creek, a half mile distant from the Middle Fork of Snoqualmie River, are several large springs having excellent properties for the treatment of rheumatism. Prospectors have quarried out of the solid rock a bath tub of liberal dimensions, and if these springs were made accessible they would become popular. Even in their present condition they have been tested, as evidenced by crutches and canes found in that vicinity.

At Madison, on the line of the Great Northern Railway, is a hot sulphur spring, very similar in taste and temperature to those at Hot Springs on the Northern Pacific Railway, of which analyses are given above. A three-story hotel is in course of construction at this point, and it will undoubtedly prove a popular resort.

On the bank of Money Creek, about 5 miles above Berlin, on the Great Northern Railway, is a small spring said to contain soda and iron, but no chemical analysis has yet been made. Gas constantly escapes from the water. The taste is not unpleasant. This spring is always visited by passing miners, and during the summer months parties frequently camp in the vicinity, to avail themselves of the waters.

On the North Fork of Skykomish River, 5 miles east of Galena, are several large mineral springs, both hot and cold. Being located in a mineral region which has been pretty well explored, these springs are well known to prospectors, but they have no general reputation.

Near Peshastin Creek, in sec. 22, T. 20 N., R. 17 E., is a cold sulphur spring which is generally considered to possess excellent health-giving properties. In

years gone by it was a favorite camping place for the Indian tribes, who came from afar to bathe in its waters. A crude bath house is maintained by persons who have located at this point, but being remote from the main traveled routes, the spring is not of much importance.

On the Little Wenache River, about 8 miles above Lake Wenache, there is said to be a large soda spring of excellent quality. As its exact location was not learned, it was not visited. It is difficult of access and visited only by hunters. It will in time add to the attractions of Lake Wenache, which is destined to become a popular summer resort.

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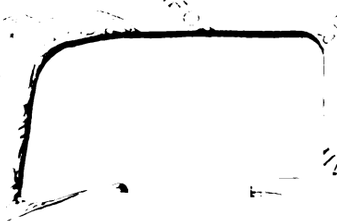

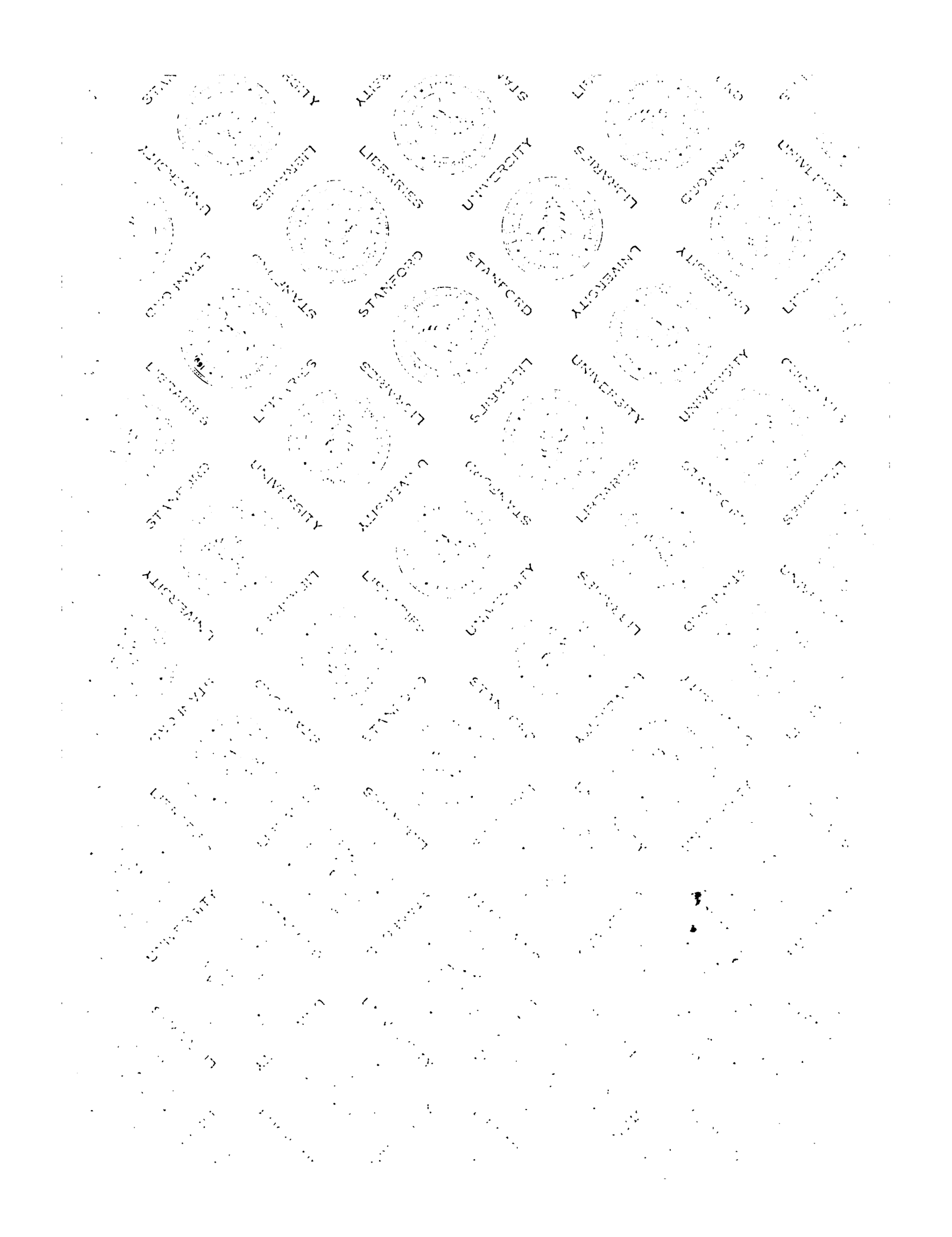
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